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NPN's cartoonist foresees Dr. Ickes "ordering" OPA to help the oil industry with a price increase

EAST COAST SITUATION: Eastern oil situation grows more acute, prompting drastic moves by PAW with more in prospect; coupon cut indicated **(P. 7)** . . . Senator Maloney starts new oil investigation, Ickes seeks more power **(P. 3)** . . . Change in Army-Navy procurement policies discussed **(cover)** . . . Bostonians get emergency fuel ration in buckets from truck parked in town square **(P. 5)** . . . An NPNer writes first-hand account of family tribulations following cut off of oil burner for lack of fuel **(P. 5)** . . . OPA cuts eastern fuel oil ration by 10% and warns non-converters **(P. 9)** . . . .

OIL MARKETING: PAW bans credit cards for purchase of gasoline at service stations and "hopes" it will mean elimination of credit cards for the duration to save bookkeeping manpower **(P. 9)** . . . Louisiana's Governor Jones gets under skin of OPA Chief Henderson who lashes back at plea to state OPA administrator to use "common sense" in granting gasoline rations **(P. 9)** . . . Marketers of Quincy, Ill., finally get relief from their "frozen" price war as OPA hikes tankwagon and retail price ceilings **(P. 11)** . . . OPA widens margins for fuel oil marketers in 30 states to cover expense of "red tape" involved in rationing **(P. 8)** . . . OPA "spells out" new price structure for light fuel oils in Boston **(P. 11)** . . . Ceilings on government bids are eased by OPA **(P. 12)** . . . Price advance to be allowed for fuel oil deliveries at Detroit stations **(P. 8)** . . . State marketing associations do their bit in war effort **(P. 4)**

TRANSPORTATION: Tank car shipments to the East drop to lowest level in over six months **(P. 22)** . . . RFC streamlines its plan for compensating oil companies on war-added transportation costs **(P. 22)** . . . Specific assignment orders are in the wind for the nation's 143,000 tank cars **(P. 20)** . . . Big pipeline set back as Mississippi flood washes out crossing **(P. 20)** . . . Truck Conservation Corps enlists over 3,000,000 in preventative maintenance campaign **(P. 24)** . . . Moving oil in 200 converted box cars is planned **(P. 20)** . . . Eastman and Land tell Maloney committee of oil transportation plans **(P. 3)**

Eastern Fuel Oil Crisis May Kill "A" Coupons

WASHINGTON — Fuel oil situation has become so increasingly acute in the East that Petroleum Industry War Council's economics committee has filed a special report here recommending drastic steps to conserve stocks and private additional facilities for bringing in more fuel.

These recommendations include immediate cancelling of all "A" coupons, scaling down of "B" and "C" coupon books and putting "T" card holders on a mileage basis—all to apply in the East only. Also, the P.I.W.C. committee suggested several changes in government oil shipping policies. Total result would increase by 169,000 b/d the amount of fuel oil available to District 1.

Some recommendations in this report were probably discussed by the Maloney committee at its conference Jan. 5 with Army and Navy officials on how the armed services could cooperate in relieving East's oil crisis.

Drain of military demand on eastern civilian supplies has been so great that stocks have been reduced to a fraction of a single day's supply in some areas. A number of colleges and schools in New England have been closed indefinitely for lack of oil.

General Oil News 3
Washington News 7
The Editor's Page 13
Refining News 15
Oil Transportation 20
It Happened Last Year—Day-by-Day Oil News through 1942 28
Equipment Personals 37
Statistics 39
Markets 41
Personals 50

REFINERY MANAGEMENT AND PETROLEUM CHEMICAL TECHNOLOGY EDITION—In 2 Sections, Section 1

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Bud would probably blush all over and feel pretty uncomfortable if you called him a "hero." He'd say, "Skip it!"

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Victor Wickersham . . .

Led Fight Against Nationwide Rationing

People have said "no" to Victor Wickersham. But it didn't stick. The voters of Oklahoma's seventh congressional district tried it twice, with emphasis, but he came back smiling for more the third time, and they packed him off to Washington, a 5-to-1 winner.

That was in the special election of April 1, 1941. He had beaten out 10 opponents in the March primary.

No sooner had he arrived on Capitol Hill than he let it be known that he wanted to be a member of the House Agricultural Committee. He got an emphatic "NO" from 6 Democratic leaders who make the committee assignments. Agriculture was too important a committee for a baby member, and besides there were 3 oldsters in line for the job.

But coming from a predominantly farming district, he wanted the appointment and really went after the job — and got it.

So when gasoline and fuel oil rationing officials gave him an assortment of "Noes" he refused to be brushed off. He wanted them to postpone the extension of gasoline rationing and give the people a chance to show what they would do voluntarily toward saving rubber. He wanted rationing regulations that would allow the farmers and the traveling salesmen enough gasoline to carry on their business, as vital parts of the war effort.

He talked it over with two other first termers, Clint Anderson, N. Mex., and Ed Hebert, La., and a second termer George Gillie, Ind. And what these "four horsemen" did is rationing history — the petition signed by some 200 congressmen opposed to extending rationing beyond the East and the protest "caucus" held while the White House was in session.

From then on "noes" began to change to "yeas" highlighted by the resignation of Price Administrator Henderson.

Although his district has some 700 stripper wells it is mostly agricultural. However, Mr. Wickersham has had his taste of oil for he once owned 3 filling stations and knows something of the tribulations of the man behind the pump. He also made a tidy sum of money out of the discovery of oil in Oklahoma City. Sensing a housing shortage, he bought up a number of old houses and moved them to vacant lots near the drillings. Things boomed until a slump came and washed out all the profits except what he had invested in a farm. A loan on this financed his campaign for Congress.

Politics is nothing new to Victor Wickersham. He has been in and out of politics he says today he is no politician. "I just like to meet people and I like to serve them," he says. And when you meet him you know it's so. He probably knows more people around the House Office Building — police, clerks, elevator men, workmen — that many other congressmen who have been there twice as long.

His political life started when he was in high school with a job in the county clerk's office, then in the court clerk's office. He became court clerk, first by appointment, then three times elected to the job. His next step was chief clerk of the Board of Affairs of the State.

He's not the first Wickersham to come to Congress. Two relatives have sat there, although they were Republicans. A few years ago there was a cousin James Wickersham from Alaska, and back of that a cousin of his father's, George W. Wickersham who represented New York.

Despite years spent in public office, Mr. Wickersham knows at first hand what farming is like. He was born on one near Lone Rock, Baxter County, Ark., and when he was 8 the family moved to a farm near Mangun, Okla., which is still his address.

He is married and has three children, La Melba Sue, Galen, and Nelda, 12, 10, and 8 respectively.

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More Power Asked

Ickes Admits He Isn't an Oil Czar, Still Needs More Power to do Job

WASHINGTON—PAW Ickes still feels the need of wider powers in administering his wartime petroleum program.

He plainly indicated as much in his testimony before Senator Maloney's oil investigating committee, which resumed hearings Jan. 4, and broadly intimated that he may seek additional powers to "plug up" gaps in his present authority.

The committee was in a respective mood. But Mr. Ickes shied at being specific.

Maloney Poses the Question

Senator Maloney came out bluntly with the question:

"Could you do more if you had more power?"

"Yes," replied Mr. Ickes.

"What additional powers do you require?" asked Sen. Maloney.

"I'd rather not elaborate," replied Mr. Ickes. "I may have something to say on that later—after I have talked with my deputy administrator and my chief counsel."

Leon is 'Poor Witness' for Harold

Later in the hearing, the more-power-for-Ickes question came up during the testimony of OPA Henderson. Sen. Maloney asked:

"Do you think Mr. Ickes has enough power?"

Mr. Henderson replied "I'd be a poor witness on that." He explained that his advice on the distribution of authority in the past had not carried much weight.

The hearing was to bring the committee up to date on developments in the petroleum field since its last meeting. In addition to Mr. Ickes, the committee heard "progress reports" from ODT Eastman, OPA Henderson, Rubber Director Jeffers and Maritime Commission Chairman Land.

Give No Promise of Relief

None of the five agency heads held out any promise of an easing in the restrictions on gasoline and fuel oil.

Mr. Ickes said he did not "feel cheerful about this winter at all," and spoke of military needs in North Africa.

"We have been living on a hand-to-mouth basis," he declared, "and we are going to continue to live on a hand-to-mouth basis."

Mr. Ickes revealed he had asked WPB's approval of a 20-in. products pipeline from East Texas to the Atlantic Seaboard to parallel the big 24-in. pipeline. The request may be stepped up to 24 inches, he said. In addition, he may ask authority to construct a third pipeline to supply the East.

OPA Henderson warned that there might be further "tailoring" of ration tickets to meet sudden crises like the one of Dec. 18. He said another crisis would not necessarily cause a "freeze" of ration coupons but a "tailoring" probably to fit demands to available supplies.

Flanked by his PAW advisers, Petroleum Administrator Ickes reports to Senator Maloney's committee on eastern oil situation. At Ickes' left is Transportation Director Major J. R. Parten; in row behind, Robert E. Allen, Gordon M. Sessions, J. Howard Marshall and E. B. Swanson

'Wasn't Tough Enough'

As "outbound administrator", he said that what he regretted was "that I have not been tough enough."

Rubber Administrator Jeffers admitted "some disagreement" between his office and the military over allocation of materials for the synthetic rubber program. The most important problem, he said, is bringing in the synthetic rubber plants, which "runs head on into 100-octane gasoline." He said the program was about 30 days behind the Baruch schedule, but he hoped to be up with it by mid-summer, if he could get the critical materials.

Mr. Jeffers said that the farmer's supply of gasoline should be "all put into one package", and that he understands a plan is being considered. He read the committee a memorandum he had addressed Dec. 31 to Mr. Henderson and Mr. Eastman, in which he declared he was "convinced that we must simplify forms and procedures and make sure that each farmer's real needs are understood by those who determine his gasoline allowance."

Must Give Farmer 'Gas'

"Present regulations," the memo said, "clearly need amendment and until simple forms can be prepared and distributed and simpler procedures set up, it is of the utmost importance that farmers get the gasoline they need for off-the-road uses, for their trucks and for their passenger cars, which often are used to take produce to market and to transport farm supplies. I shall appreci te it, therefore, if you will immediately make whatever amendments are needed to insure, between now and March 31, that no farmer or stock raiser lacks gasoline to carry on operations essential to his maximum production."

Favors Waiving Present Rules

Until new regulations are drafted, Mr. Jeffers said he favored giving farmers whatever gasoline they need and waive present rules.

At a press conference later, Mr. Henderson said he didn't believe Mr. Jeffers meant to say that, nor did he think the rubber director meant to say any regulation issued by a government agency should be ignored.

Mr. Eastman told the committee that WPB had authorized construction of 392 tank trucks in January and that 500 more were to follow to increase the eastward movement of fuel supplies. He said the railroads had agreed to reconstruct, on an experimental basis, 200 box cars for carrying oil.

273 Tankers Now Being Built

The railroads, Mr. Eastman said, have already spent $10,000,000 improving facilities for moving oil, other than rolling stock, and were planning to spend an additional $8,000,000.

Maritime Commission Chairman Admiral Land told the committee he has under construction 209 ocean going tankers, 64 coastal tankers, and 52 concrete barges scheduled for completion during 1943. In addition, 5 tanker yards will be completed this year. He held out no hope of relieving civilian needs by use of ocean-going tankers during the next 12 months.

Oil Associations Do Their Bit

Scrap Rubber Drive Highlights the Record of Oil Marketing Associations During First Year of the War but They Were Active on Other Fronts, Too

"Divided we fall" is the last and ugliest half of an old but oft-proved motto. The other half, "United we stand", expresses the foundation upon which the oil marketer associations of the country built a remarkable record in 1942—our first year in the second World War—a year calling for the most forceful group action by the "small business men" of the oil industry in the nation's history.

To say merely that oil marketer associations lived up to what was expected of them is an understatement. They were in there fighting for the very existence of small oil men. They were battling mishandling of ill-conceived "war programs". They were putting their considerable weight behind sensible wartime activities.

Scrap Rubber Drive Put Across

For an example, take a look at figures on the scrap rubber drive—only one of the marketer association efforts in 1942. Without the all-out drive by the nation's small oil men, this program would simply have been "another drive". When it ended, even President Roosevelt handed the oil business an orchid for a job well done.

Every oil marketing association pitched in and made the scrap rubber drive a success. They didn't go about the job half-heartedly. With the same enthusiasm that oil men go after making sales quotas, they pitched in and spent their time, money and effort and put it over. They all did a good job.

Indiana Independent Petroleum Association's part in the rubber drive is an outstanding example of how a united organization functions in activities to aid the war effort.

Indiana Association Was Active

Indiana's scrap rubber score was 18,893 tons—11 lbs. per capita. To accomplish this, Indiana's oil men saw to it that every man, woman and child in the state was reached with an appeal to turn in rubber. Every county, township, town, village and city was organized. Ninety-two oil men as local chairmen were given the responsibility of collecting 42 million pounds of scrap rubber. Radio, newspapers, billboards, handouts, special editorial writers were used in promoting the drive. Movie "rubber matinees", with rubber scrap as the price of admission, were held. A "committee of ten thousand" to promote the drive was organized. Forty-six major oil companies' best men were borrowed for the drive. The Governor and state officials, motor clubs, farm bureau members, truck drivers—these were all brought in the picture by J. G. Sinclair, chairman of the Indiana scrap rubber drive.

Illinois Places Second

Another association—Illinois Petroleum Marketers' Assn.—was also especially active in the rubber drive. President Rosenthal and Secretary Primm succeeded in placing Illinois second in amount collected. Nebraska Petroleum Marketers, Inc., was still active in December, cleaning up any rubber on hand.

Equally successful were the scrap drive activities of all other associations. There are few of the country's newspapers that haven't told in word and picture oil's part in making this drive a success. Among the associations showing exceptional results was the Michigan Petroleum Assn. This association appointed 83 key men in each of the counties to act as chairmen in their respective communities.

The ODT truck conservation program was another activity joined wholeheartedly by all of the associations. In addition to the government's program, some of the associations worked out truck conservation plans of their own. South Dakota sponsored a plan whereby all of the jobber members carried on a joint advertising campaign to customers.

Legislative activities and work in opposition to restrictions and regulations inimical to the petroleum industry was another activity of association officers in busy 1942. The score has been especially pleasing.

Kentucky Group was Active on Legislation

The Kentucky Petroleum Marketers Assn. for instance, opposed 4 adverse bills in the legislature, all of which failed to pass. These bills included the proposed truck license increase of 150%; a gasoline inspection and grading bill; a license on gasoline dispensing pumps, and exemption from gasoline tax for non-highway gasoline.

Also, the Kentucky association was successful in getting enacted 3 bills which they favored. These were: Increase of truck minimum weight limit from 18,000 to 28,000 lbs.; authorization releasing gasoline tax collection information; checking dispensing equipment for accuracy, without fee, by the Weights and Measures Department.

Truck Tax Law Beaten in Courts

The Indiana association succeeded in getting the truck law tax method of taxation declared unconstitutional after a long and bitter fight. The association is now fighting for the establishment of gasoline carload charges as maximum for distillate fuel oil to Indiana from the Southwest. Another fight the association is carrying on is for the 6% increase in freight rates to be charged to consumers and for some kind of method for adjusting prices where they would be based upon crude oil, establishing a differential above that for tank car and tank wagon.

Tennessee Oil Men's Assn. is all geared up to work in connection with a new legislature now convening.

Iowa Joins in Fuel Oil Rate Case

The Iowa Independent Oil Jobbers' Assn. was a participant in a fuel oil rate case before the ICC Docket in 1942. It protested before the ICC against the 6% freight rate increase which became effective March 18, and urged the OPA to permit the increase to be passed on. The association was responsible for getting truck transporters weight limitations raised for the state of Iowa. This resulted in releasing tank cars for the East Coast.

Savings for Michigan Jobbers on Tax Bonds

Michigan Petroleum Assn. saved the petroleum industry $45,000 annually by sponsoring a bill for reimbursement by the state for the amount of premiums paid by jobbers on gasoline tax bond.

Nebraska Petroleum Marketers, Inc., among other legislative activities, spent 2 months touring the state, holding meetings 4 nights a week in connection with a constitutional amendment making it impossible for the state legislators to divert gasoline tax collections to any other use than for highway or bridge purposes. President LeRoy L. Snyder and Secretary H. H. Hahn personally attended all of these meetings.

Kansans on Alert for 'Gas' Tax Move

Kansas Oil Men's Assn. is on record and is watching for any moves to increase federal gasoline tax, lubricating oil tax or increases in pipeline tax and the elimination of the depletion clause.

South Dakota Independent Oil Men's Assn. was successful in having bond premiums reduced from $25 a year to $12 annually. It is also sponsoring amendments and legislation of various kinds. Among them are: Amendment of the motor fuel tax law; the repeal of the Sessions laws relating to the hauling of inflammable petroleum products; adoption of the American Assn. of State Highway Officials plan for motor truck laws; adoption of reciprocal agreements between neighboring states; amendment of a bill to reduce inspection fees; enactment of uniform closing laws; and a law providing for the refunding of taxes paid on gasoline lost by theft and leakage.

Northwest Group Goes to Washington

The Northwest Petroleum Assn. has protected the interests of its members by contact with governmental agencies in Washington and their branches throughout the country on matters pertaining to the oil business. The secretary, E. E. Hadlick, made frequent trips to Washington, Chicago and other points in this work.

The North Carolina Oil Jobbers Assn. officials have spent much time in preparing a program for the legislature, now in session. Among these are the repeal of the direct pump tax, reduction in license or privilege taxes, prohibiting the refund of gasoline taxes except upon the presentation of receipted bill, refund of taxes paid on gasoline which was later destroyed by acts of God.

Bulletins Pour Out to Members

Association activities in 1942 hit an all time high in the number of bulletins and letters sent to members. Most of the associations issued long bulletins every 2 weeks, some of them even oftener. These were devoted mostly to new governmental orders, directives, changes and the like. Some of the associations interpret the orders, but mostly they are issued just as received.

The North Carolina association sends its members weekly bulletins in which Secretary W. A. Parker does a splendid job of interpretation. Important items are sent the members by special letter form which, the secretary advises, often results in jobbers having information before their supplier informs them.

Join Fight to Postpone Rationing

The activities of the various associations in

the fight for postponement of nationwide gasoline rationing was one of the outstanding features of the 1942 association news activities. While rationing is now nationwide, the associations have in no sense let down on their activities in this respect. They are cooperating in the program, but are pointing out inequalities as they develop.

A good example of the attitude of some of the associations is that of the Nebraska Marketers, whose president, LeRoy L. Snyder says:

"The president and other members of our association attended several joint meetings of the Central States Assn. the latter part of May and launched a strenuous campaign against rationing as of July 1. As a result of mass meetings we helped forestall rationing in the Midwest as a group until Dec. 1. When it looked hopeless in the fall, we thought it be better to let it go into effect and then squeal loudly if they did not handle it properly, which now appears to have been the proper thing to do. It now looks as though we are going to accomplish something in the way of clarifying the forms used, and also of cleaning up some unessential rationing, such as fuel oil, particularly in Nebraska."

Membership in the associations in 1942 has generally been better than any time in their histories.

War has levied its toll on membership in the associations, as well as officers. Kentucky's president, O. A. Bakhaus, is now a captain in the army. Ohio's vice-president, Sam Bohlen, is in an officer's training school. Other association officials serve on industry war committees.

A complete review of association activities would fill NPN. Probably they could be summed up in the words of Iowa Independent Oil Jobbers' Assn. secretary, A. C. Gienapp, who closed his report by saying:

"The Iowa Independent Oil Jobbers' Assn. is very much alive and will exert every ounce of energy in winning the war and to preserve the independent oil jobber to the fullest extent of its ability."

Acknowledgment

This salute to oil marketers' associations is made possible by the splendid cooperation of association officials who took the trouble over a busy holiday week end season to answer NPN's request for a resume of association activities during 1942. Our special thanks to:

Herbert Clay, secretary-treasurer, Kentucky Petroleum Marketers Assn.; J. D. Hadley, executive secretary, Michigan Petroleum Assn.; Leroy L. Snyder, president, Nebraska Petroleum Marketers, Inc.; C. E. Holmes, secretary, Kansas Oil Men's Assn.; Robert A. Warfel, secretary, Ohio Petroleum Marketers Assn.; G. A. Primm, executive secretary, Illinois Petroleum Marketers Assn.; Elwin E. Hadlick, executive secretary, Northwest Petroleum Assn.; J. E. Adrian, secretary, South Dakota Oil Men's Assn.; W. A. Parker, secretary, North Carolina Oil Jobbers Assn.; George Hofmayer, secretary, Indiana Independent Petroleum Assn.; Lucile Warden, executive secretary, Tennessee Oil Men's Assn.; A. C. Gienapp, secretary, Iowa Independent Oil Jobbers' Assn.; and M. B. Whiting, president, Virginia Petroleum Jobbers Assn.

Out of Oil, Patience Exhausted

Living in the Washington Area, NPN News Editor Petty Writes First-Hand Of His Family's Tribulations with Oil Burner Cut Off for Lack of Fuel

By A. M. PETTY, NPN News Editor

ALEXANDRIA, Va.—Newspapers headline the bad news of OPA's 10% cut in January fuel oil coupons, but that doesn't bother the Petty family—we used up all of our January coupons sometime ago.

Now, 70 gal. remain in the tank to carry us until Feb. 3 when the Period 4 coupons can be used. We have used 665 gal. of oil since Oct. 1. And it is only a small, 6-room house. But what a jerry-built oil eater! Last year's tenants used 2015 gal. "and still couldn't keep warm". Our ration coupons totaled 1080 gal., or exactly 50.02% of last year's consumption (a winter that was about 15% warmer than normal).

We may get another 120 gal. in coupons because of a mistake in our fuel oil application. Even that won't do much good, if the temperature again drops below zero like it did just before Christmas. Then we had the oil burner, fireplace and kitchen range going full blast but still the wind whistled through the windows. In four days, we burned 75 gal. of oil—or more than we have left now to last a whole month.

OPA Ration Board Turns Deaf Ear

The local OPA board told us flatly, "there simply is no provision in the regulations for us to grant supplemental rations." And it made no difference that OPA's rationing formula overlooked the factor of no basement or that illness had increased our fuel requirements.

Since my tour of the local OPA officials, however, I have learned that there *is* an "auxiliary ration" form for special cases—such as aquariums. And I'm old-fashioned enough to believe that children are just as important as fish. Maybe the ration board chairman will think so, too.

Fireplace Helps, If Phone Doesn't Ring

Bundled in a sweater, close by the fireplace, I'm fairly comfortable writing this at home. But 6 ft. away a thermometer reads 58. Stacked in the corner are seven 50-lb. bags of coal. Shades are drawn, and the double door to the porch is boarded up. Thermostat in the dining room is shoved back to 50. The burner used to come on at 50, but we found cutting down the aquastat stopped that.

In fact, our burner runs less than an hour a day now, and that only for *necessary* hot water to bathe the youngsters or do their laundry. (Mother and dad take their baths cold, except for taking off the chill with a kettle from the kitchen stove. And our bedroom is heatless—the temperature runs about 10 degrees above the outside. Right now it's about 35 outside.)

On the sofa before the fire, 7-year old Barbara lies wrapped in a blanket and running a 103-temperature. Upstairs, two other daughters—one 4½ and the other, 11 months—sleep in a bedroom warmed by two electric-coil heaters. Those heaters, using up 1460 watts, have been plugged in continuously for over two weeks. The electric bill will be staggering, but children won't freeze (unless we get another zero wave).

How Does OPA Figure Children?

It beats me how those OPA economists could figure that 75 gal. a year was enough "supplemental ration" for children under 4 years. In the first place, why draw the line at 4? Doesn't a child of 4 or 5 need more heat than a grown-up, especially working adults away from home all day? And what about youngsters of school age—don't they ever stay in when they come home on a blustery, damp day?

I swear softly. My wife looks up and smiles. She knows that I am thinking of either OPA's fuel rationeers or else that "friend" of ours in Richmond who has only an "A" gasoline ration (3 gal. a week) who still manages to drive up and back to Washington each week (225 miles roundtrip). Indeed, we are both so worried over fuel oil that we begrudge every gallon of gasoline used by "B" and "C" card holders driving around to bridge parties. We figure every gallon of gasoline wasted by OPA's "coupon inflation" is one gallon less fuel oil for us or others in a similar plight.

Searches Want Ad Columns

Mrs. Petty returns to her newspaper reading. She is searching the classified ads for a place to move. Yes, we took the ration board chairman seriously when he told me, "Guess you had better move somewhere's else." And when I asked where, he replied, "That's your business, not ours." So, we keep close watch on the "houses-for-sale" columns. There just isn't any "for-rent" column, although half a column of "wanted-to-rent" ads plead for any kind of house or apartment in the overcrowded Washington area.

But it won't be easy to move. We have a lease. And it seems that OPA won't help us get out of it.

Today, Mrs. Petty telephoned the local OPA rent board to ask if "hard-to-heat" was reason enough to break a lease nowadays. The OPA official brilliantly suggested: "What you need is more oil." When told we couldn't get any more oil, the OPAer replied, "Only thing to do then is move." With admirable restraint, Mrs. Petty pointed out that was the same advice given us by the OPA ration board chairman and that now we wanted OPA's rent board to help us move. But the only reply was, "That's something for *you* and your landlord."

Moved to Washington by NPN

The Petty family's troubles really began last spring when NPN decided that its news editor should go down to Washington for the duration. For 10 days, I scouted around for living quarters to rent. There seemed to be none available. So, I jumped at the chance to rent a cool-appearing house in an oak grove on a hill in Alexandria, 7 miles south of Washington.

It was springtime. The brick, cottage-type

house looked attractive. I paid no attention (but the wife did later) to the fact that it had no attic or basement, or that the walls and roof were uninsulated, with plaster slapped right on top of the outer brick wall. The six rooms were all about the size of peanut shells. And there was a hot-water heating plant, with oil-fired boiler. (It couldn't be converted and, even so, there isn't room to swing a shovel in the 7 x 9 furnace-laundry room.)

'Take It Up with Leon'

Later, we learned lots of heating disadvantages about the house. Floors of the rooms downstairs were laid across rafters, about a foot above the ground. Pipes to downstairs radiators ran beneath the house and had no asbestos covering. Our attempt to heat the "whole out-of-doors" failed but the warm place under the house did attract chipmunks and stray cats. (The cats are meowing their complaints now because we cut off the burner—but let them take it up with Leon Henderson.)

Our first doubts about efficiency of our summer-winter hookup cropped up early last summer. The burner itself supplies hot water, summer and winter. On May 31, our fuel oil supplier delivered 100 gal. But the tank went dry on July 2. And the Lord knows with Washington weather we didn't use any of that oil for space heating. Even with the hot water needs of three small children, we were still using too much oil. So we called in a burner repair man, then a plumber (the landlord hadn't shown much interest since OPA had shaved his rent).

The burner man could suggest nothing. The plumber thought a valve here and there would help—but, he shrugged, "priorities—."

Through the summer we didn't worry much. It looked like Mr. Ickes and the oil industry would get us enough oil (none of us counted on the military seizing supplies so unexpectedly). A 7-week illness through the fall delayed me in preparing my fuel oil ration application (we had to locate the former tenant to get last year's consumption—2015 gal. for 1067 sq. ft. of floor space). Meanwhile, the doctors had prescribed a warm room and scalding hot baths for me. And that used up plenty of oil.

We didn't know where we stood until the coupons finally came and we settled with our supplier for "promissory notes" on couponless deliveries. That took all of our coupons for Periods 1, 2 and 3, plus 50 of our "change coupons". And it left us with only 115 gal. in the tank to last until Period 4 (February).

On the OPA's Merry-Go-Round

Next day, I went over to the local rationing board's office. I got there an hour before they opened and took my place in line. Gradually, I worked up to the desk. The telephone rang continuously. But the clerk gave it no thought. "If we answered it, we never would get any work done," she said. And then I found that I was in the wrong pew.

"We take only new applications here," said the clerk. "Any complaints must be taken up at the ration board. Fortunately, it meets tonight at the Armory."

At the Armory that night I was again an hour early. But there were others ahead of me. This time there were benches to sit on. And, as we waited, we traded stories. There was much bitterness at complexity of the rationing forms. (If Leon Henderson were where some of those people wished him, he'd have no fuel oil worries.)

The lady next to me said she had received 192 gal. for the whole year and already owed her supplier 339 coupons.

Her experience with the ration board members tipped me off what to expect. They got out her application and checked to see if the ration had been correctly computed. Yes, it was correct.

"But what am I going to do," she pleaded when told she could have no more coupons.

"You have been using too much oil—what's your thermostat set at? Sixty-eight? Why that's way too high. You must cut back much lower than that."

The ration board chairman's reply infuriated the lady. She told him about her sick child. The chairman took it all resignedly (he must catch aplenty).

"Madam, there's nothing we can do about it—the regulations don't provide for any supplemental rations," he said.

'Not Even Henderson Would Do That'

Meanwhile, my ration computation had been checked. It, too, had been correctly figured. I tried to point out that the formula didn't consider a basementless house, that illness had run up our consumption and other factors. But it was no use—no supplemental rations were being granted.

"You are lucky we didn't penalize you for late filing of your application," said the chairman, thumbing through his book of rules.

"Not even Leon Henderson would penalize a man for being sick," I retorted. And then I asked what we could do. His suggestion was to move to another house.

Checking over the application myself I found that I had put down as my inventory, the total on October 1 *after* the supplier had made a delivery. That meant the inventory was deducted from my basic ration *and* the supplier had collected coupons, also. This had cost me 120 gal. Yes, said the chairman, that inventory question had confused many people and if I would write a memo, get it notarized and bring it back I could have coupons for 120 gal. more. But the board wasn't there the next night—and I haven't been able to locate them since.

At the board's office a day or so later, the clerk again pointed out that they accepted only "new" applications, that complaints were handled by the board itself, etc., etc. When would the board meet again? Well, it might be a week and again it might not be for a month. Finally, the clerk agreed to take our notarized memo and "bring it to attention of the board".

Meanwhile, we have no space heating except the fireplace, electric heaters and the kitchen range. And we can only pray that the temperature doesn't fall low enough to require turning on the burner.

Also, we are looking into the question of whether the Petty family, like the fish in the aquarium, can't get an "auxiliary ration".

P. S. Since writing the above, Mrs. Petty has telephoned the office to say she and the kids were "evacuating" temporarily. Forced out by high winds blowing down the chimney and smothering the coal fire in the fireplace, they are spending the day with relatives.

Bostonians Get Emergency Kerosine off 'Peddler' Trucks

Special to NPN

BOSTON—When the severe co'd wave of the Christmas weekend caught many Boston householders without sufficient kerosine to meet their heating requirements and unable to secure more through their regular supply sources because of the critical East Coast shortage, Boston Ice Co., through the city police department, provided temporary supplies to those needing additional oil.

Correctly surmising that the police department was the first agency to which householders would turn for relief in the emergency, company called headquarters to put their supplies at police disposal. Lots of 5 to 10 gal. each, enough for 2 to 3 days' supply, were meted out to residents in Charlestown, Roxbury, Cambridge, and other sections.

Benjamin Waldman, manager of the company's fuel division, said that about 60 of the company's "peddler" trucks were sent to police-designated centers in the city where lines of men and women carrying 5-gal. oil cans formed to get their allotments. In other districts, oil was passed out from the platforms of the company's plants scattered through the city.

Ration coupons were collected for the amount delivered to each person.

—Press Association photo

NPN Reports

War Oil News and War Orders from

WASHINGTON

For ALL branches of the Oil Industry

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Quota vs. Coupon

PAW Overrides OPA's Ration Coupons With Quotas and Preferred Consumers That Must Be Supplied Before Others

NPN Staff Special

WASHINGTON—To offset OPA's "coupon inflation" and bring coupon demand into balance with eastern supplies, Mr. Ickes' petroleum administration has superimposed a "priorities system" on top of OPA's rationing program for the East.

PAW has issued a specific list of consumers entitled to preference. And oil companies have been ordered to take care of this list first. It is a further extension of the quota system set up by PAW in Petroleum Administrative Order No. 1.

In a nutshell, PAW is saying to primary suppliers:

"Here's how much oil is available to you, and here's a list of consumers you must take care of. If you have any supplies left over, you may sell them to other customers."

Who Rations Secondary Suppliers?

No provision was made in PAW No. 1 for quotas to secondary suppliers (wholesalers, jobbers, etc.) or to dealers. Presumably, it was left to each primary supplier to "ration" his resellers according to their percentage of "essential" consumers. But this opens up all sorts of headaches for the supplying companies. And, if the system is continued beyond the present crisis, they may insist that the government assume responsibility for quotas to secondary suppliers.

OPA went along quietly enough—probably because of the emergency—with PAW's move. But some of the OPAers definitely felt that PAW was "invading" OPA's rationing field. However, OPA may salve its feelings by issuing an order that will "spell out" the types of consumers not entitled to get fuel oil. In other words, OPA would list specifically those consumers omitted from PAW's preferred list.

Everyone But Movies and Churches

Virtually every type of fuel oil consumer—except churches and places of amusement—were put on PAW's preferred list. For gasoline, however, PAW drew the line tight, giving preference only to war workers, farmers, doctors and others performing services essential to public health and safety. (For complete list of preferred consumers, see text of PAW order on Page 10 of this issue.)

Setting of quotas for areas and individual suppliers, based on 1941 sales, is bound to cause some dislocations. Some areas, like Washington, have had a 30% increase in population in the past year. So, a limitation on supplies based on a reduction below 1941 figures will cause hardship.

This same situation arose under OPC's L-70 system of curtailing gasoline deliveries to resellers last year. And the "out" then was for OPC to quietly issue a directive increasing the area quota by a certain percentage. For sometime, OPC did not make these directives public, simply notifying the major companies in the area and relying on them to advise their resellers of the quota increase.

Some kind of system for adjusting suppliers' quotas, when proved necessary, is contemplated under the new PAW program. But no details could be obtained, except that Deputy Administrator Davies has designated Charles Harding, attorney in PAW's New York office, to handle complaints about quotas.

What About the Missing 32,000 Bbls.?

PAW has issued a list of quotas for primary suppliers in the East for January. Total of the daily quotas allotted each supplier in each zone amounts to 1,085,000 bbls. But PAW has informed OPA and the world in general that available supplies amount to 1,117,000 b/d. Maybe this 32,000-bbl. difference is to take care of adjustments made by PAW Attorney Harding. Or maybe it was to provide for suppliers on the fringe of District 1.

Quotas and Coupons Conflict

Portent of PAW's quotas and preferred consumer list has caused much speculation. It *could* foreshadow a move to shift from OPA to PAW the responsibility for restricting consumer demand to supplies available.

Marketers were complaining of a "conflict" between PAW quotas and OPA coupons even before the preferred consumer list was released. And they were demanding that one or the other system be dropped.

Atlantic Coast Fuel Oil Conference, through its executive secretary, Clyde Morrill, Boston, contends that the coupon-quota conflict was the "fundamental cause" of marketers' troubles at present.

In a letter to Chairman Carnes, Mr. Morrill asked that the District 1 Marketing Committee study whether or not it should recommend dropping either coupons or quotas.

"It may be," Mr. Morrill said, "that the entire coupon plan can be considered, after trial so far, as being far too cumbersome and complicated to ever effectually carry out the job it was intended to do."

One thing that the PAW preferred list does do, however, is build a firm foundation for PAW to insist that OPA wring the water out of its rationing system by reducing coupon values or altering the whole A-B-C gasoline coupon set-up to provide only for "essential" requirements in the East.

In the past, OPA has failed to heed Mr. Ickes' warnings about "coupon inflation". Cuts that were made by OPA were not as deep as Mr. Ickes is understood to have recommended. And these occasions were marked by disputes over current consumption, with OPA insisting that the number of coupons out was in balance with eastern supply.

Now, the PAW quota system and preferred list will point a finger at any non-essential consumer who still has OPA coupons. And he may find himself with coupons but no place to spend them.

Coupon value cuts, however, are not the final answer. They hit the essential user as well as the joy-rider. And continuance of a blanket reduction in coupon values will endanger the transportation system—by laying up automobiles used in car pools, etc.—and otherwise threaten the whole civilian economy.

So, all signs point to a complete recasting of the OPA coupon system—if not its elimination—in the East.

'I'll Raise Hell If I'm Cold,' Henderson Tells News Men

WASHINGTON — Leon Henderson learned something from the tactics of those who opposed his rationing plans.

Meeting newspapermen in a press conference Jan. 4, Mr. Henderson was asked, in connection with conversion, what would happen if there is a coal shortage next winter.

There was silence for a moment.

"Next winter—" he said, and stared at the ceiling a minute through dark glasses (one reason given for his resignation was bad eyes). Then he answered his questioner directly. "Next winter," he said, "if I'm in a climate that uses coal or oil and if I get cold, I'm going to write letters to congressmen and the railroads and raise merry hell as a private citizen."

His reply brought a roar of laughter from newsmen.

P–98 Squeaks By

Order Extended Again at Last Minute; P-98-b Now Assigns AA-2X Ratings, P-98-c Allows Transfer of Equipment

WASHINGTON—Significant changes have been made in the oil industry's priorities structure under new orders issued by WPB.

P-98-b, the general oil priorities order, due to expire Dec. 31 was extended at the last-minute (as usual) but this time for an indefinite period. And certain changes made.

P-98-c was also extended indefinitely and amended to allow a supply house to act as intermediary on sales of equipment between operators.

Top-most of the changes in P-98-b is assignment of a AA-2X rating—in addition to A-1-a and A-2—which is the second highest rating assigned by WPB. The higher is A-1-a. There also is an A-2 but by a quirk in the priorities system it ranks equal with A-1-a, a WPB official said.

Also of considerable importance—and a major departure from previous orders—is that P-98-b ratings may be used to obtain materials costing less than $500 for plant alterations.

Restricts Use for Station Equipment

A third new feature is a restriction on the materials which may be obtained for service station use by the ratings assigned by the order. PAW countersignatures are required for orders for less than $100 needing an A-2 rating; for orders costing $5 or less needing an A-1-a rating when they are for drills, reamers, taps and hacksaw blades made of high speed steel, hand service operating tools, precision measuring hand tools, and portable electric tools when such equipment is to be used in service station operations.

Now, the 3 ratings assigned by the order—AA-2X, A-1-a and A-2—may be used to obtain:

What It Can Be Used For

1. Research laboratory equipment except material used in constructing a building or other structure.

2. Materials costing less than $500 for alterations.

3. Repair, maintenance and operating supplies.

4. And to obtain material to be used "in any operation directly incident to the discovery, development or depletion of petroleum pools".

WPB's approval—obtained by submitting an application via PAW—is necessary before A-1-a may be used to obtain material costing $500 or more, and before AA-2X may be applied for any item. However, district offices may approve an AA-2X needed to secure material in the case of an actual breakdown or suspension of operations.

PAW countersignatures, given by district offices, are now required for A-2 orders of $100 or more and for A-1-a orders of between $5 and $500.

P-98-c Changes

The change in P-98-c, also issued Dec. 31, was designed to let suppliers act as brokers in sales between operators, PAW said, pointing out that heretofore oil operators were required to sell material directly between themselves.

Meantime, PAW reported it is giving fast action to P-98-b applications, asserting applications sent to Washington are cleared in 3 days while field offices usually give 1-day treatment to applications.

During October, PAW said, district offices and the Canadian oil controller's office—whose authority to countersign application is continued under P-98-b—countersigned about 9600 applications for materials valued at $950,000 and PAW here approved 364 applications for materials worth $1,098,428.

During the week ended Nov. 30, PAW reported, its Washington and district offices and the Canadian counterpart issued 2334 certificates valued at $4,427,652, with 71% under P-98-b and 27% under PD-1A applications. An additional 2% was made up of project authorizations, and 47 certificates were issued for foreign operations.

About 17% of the certificates were for raw materials and 83% for fabricated products.

To Allow Fuel Oil Price Increase At Emergency Station Outlets

CLEVELAND—An amendment to Price Regulation 137, permitting fuel oil prices 3c above tank wagon at emergency fuel oil distribution stations in 5 counties in the Michigan area, will be issued shortly, regional office of OPA here said today.

Tanks at 375 service stations have been prepared to dispense the fuel, with a goal of 500 stations on the program, designed to "relieve the lack of trucks and drivers", an OPA official stated.

The program was worked out as a result of a meeting held last week by Detroit jobbers and OPA officials. The jobbers designate the "emergency fuel oil stations" and convert one of the gasoline tanks to this purpose. Average storage is 750 gal.

"There is some talk," one local OPA official said, "that the emergency may call for discontinuing of Ethyl at some stations."

DPC Awards $13,000,000 Contract

WASHINGTON — RFC Chairman Jones announced Jan. 5 that Defense Plant Corp., an RFC subsidiary, has authorized "execution of a contract with Standard Oil Co. of Indiana to provide plant facilities in Illinois at a cost in excess of $13,000,000. These facilities will be operated by Standard Oil Co. of Indiana, title remaining in Defense Plant Corp."

OPA Ups Margin

Recognizes That Rationing 'Red Tape' Has Hiked Fuel Oil Marketing Cost

WASHINGTON — The oil industry's higher costs of operation, due mainly to rationing red tape, were recognized by OPA when it granted a 0.3c per gal. increase in the price of fuel oil.

The 0.3c boost in tank wagon prices—dished out by Amendment 53 to Price Schedule 88, effective Dec. 29—applies to all fuel and heating oils, including kerosine, range oil, Nos. 1, 2, 3, 4, 5 and 6 fuel oils, gas oil and Diesel oil, sold in the 30 fuel oil rationed states.

A companion order—Amendment 15 to Maximum Price Regulation 137—gives the same increase in prices for kerosine, No. 1 fuel oil, range oil and Diesel oil sold at retail establishments in the rationed zone.

Reasons for permitting the price increases are contained in following excerpts from OPA's statement of considerations:

Gives Reasons for Advance

"Upon appropriate investigation and consultation with representative members of the industry, the Price Administrator has determined that the rationing of fuel oil pursuant to Ration Order No. 11, as amended, issued by the Office of Price Administration, has resulted in substantial increases in costs to persons engaged in the business of delivering fuel oil in tank wagons which amount in the aggregate to approximately .3 of a cent per gallon.

"Firms distributing fuel oil in tank wagons have already been subjected to substantial cost increases since the October 1941 base period designated by the schedule for computing maximum prices. These have arisen out of higher transportation costs resulting from the 6% freight rate increase authorized in March, 1942, the recently imposed tax of 3% on transportation and increased labor costs. The Office of Price Administration has not permitted these costs to be reflected in tank wagon maximum prices established for sellers of fuel oil. It is the opinion of the Price Administrator, however, that in view of the increased costs to which they have been subjected, these sellers cannot in general absorb the increased expenses incident to rationing without serious risk to their continued operations.

To Remove Distribution Threat

"In order, therefore, to remove a serious threat to the distribution of these vital commodities, it is deemed appropriate to increase the maximum tank wagon prices of these products by the amount of .3 of a cent per gallon and thereby to increase the margins of such sellers by that amount. This amount will, in the judgment of the Administrator, afford compensation for the increased expenses ascribable to rationing."

Ban Credit Cards

PAW Directive Halts Credit Sales of 'Gas' on January 1 to All but Truckers and Government Vehicles, They Have Until February 1

WASHINGTON — Total elimination of credit cards for purchases at service stations was the intent of PAW Directive 62 although its wording only bans credit sales of gasoline. And PAW hopes that all oil companies will call in their credit cards.

Reason why purchase of lube oils and other petroleum products was not included in the credit card ban was because this would have meant prohibiting the use of charge accountants at department stores, groceries, drug stores and other retail establishments selling lube oils or specialty products.

Effective Jan. 1, 1943, the PAW directive forbids extension of credit for gasoline purchased at retail outlets, except that credit cards issued to truckers and operators of government vehicles may be honored until Feb. 1, 1943. The directive specifically states that it does not intend to ban use of government requisition books to buy gasoline.

The directive permits credit sales of gasoline at a single retail outlet. However, this provision was intended to allow independent dealers to continue carrying their own accounts (provided they get no new help from their suppliers). It was not intended that this provision should authorize a marketer to designate one of his stations as an outlet where credit cards would continue to be honored.

Also, the directive does permit credit card use for lube oils, spark plugs and other items at service stations. But the intent of the directive was that credit cards should be dropped entirely. So, any such use of credit cards would be contrary to the "spirit" of the directive, it was explained.

War Council Recommended It

Elimination of credit cards for purchase of petroleum products at any retail establishment was the recommendation of the Petroleum Industry War Council. However, it was found that such a broad prohibition would extend the order far afield from service stations. In other respects, the PAW directive followed the P.I.W.C. recommendation.

In explaining the reasons behind the move, PAW's announcement of the order, which was made public Dec. 30, said:

"The directive was issued to enable wholesale marketers to reduce costs of bookkeeping and personnel, according to Deputy Administrator Ralph K. Davies, who said that 'with gasoline sales drastically reduced by rationing, many marketers are having difficulty in continuing operations because of decreased income and increased costs.' "

Mr. Davies earlier had prepared the industry for the order by wiring general committee chairmen on Dec. 14 that "we expect very shortly to issue an order in harmony with the intent of the (P.I.W.C.) resolution, and I inform you now so that the industry may hold in abeyance or abandon any plans it may have for re-issuance of cards for the coming year."

In regard to the extension until Feb. 1 of the use of credit cards by vehicles displaying "T" ration stickers, PAW said: "This provision was included to give the trucking companies and government agencies time to make other appropriate arrangements so that trucks hauling war goods or government cars on essential business will not be unnecessarily delayed."

The extension followed protests by the Army, Navy and American Trucking Assn., who contended the ban on credit card sales would interfere with motor truck operations.

The directive forbids any marketer to influence an operator of a retail outlet to sell motor fuel on credit by giving the retailer unusual or abnormal money advances, credit or merchandise.

Non-Converters Hit As OPA Seeks To Cut Consumption

WASHINGTON — Indicative of the growing trend—inspired mostly by PAW—to bring rationed demand within the bounds of available supply, the government officially has taken 2 steps to cut down on fuel oil use.

Foremost was a statement from Leon Henderson that OPA means business when it says conversion is mandatory.

"We have given commercial property owners months to do their wartime duty in this matter," he said Jan. 3. "But there can be no further delays. The policy now is definitely 'no conversion—no oil'."

He said all commercial buildings—apartment houses, hotels, theaters, office buildings —which can convert must change from oil to coal or lose their oil rations by end of January.

"I am instructing local boards to turn down flatly any request for oil from commercial property owners whose efforts at conversion have been anything short of the maximum demanded by the oil situation," Mr. Henderson continued.

Must Prove Conversion Impossible

Commercial property owners must prove it is absolutely impossible for them to convert.

The second step taken toward balancing of supply and demand was a 10% reduction in fuel oil coupons on the East Coast.

Effective at 12:01 a. m. Jan. 4, Class 1 coupons, formerly good for 10 gal., were worth 9 gal., and Class 2 coupons, formerly valued at 100 gal., will be worth 90 gal. This was announced Jan. 2 by Mr. Henderson.

Simultaneously, through Amendment 20 to Ration Order No. 11 effective Jan. 8, OPA said it was simplifying rationing of light fuel oils by permitting consumers of more than 100,000 gal. monthly, for purposes other than heating, to use delivery receipts instead of coupons. Residual oil has been sold by means of delivery receipts for some time, OPA said.

Under Leon's Skin

Henderson Lashes Louisiana Governor For Asking State OPA Administrator Use 'Common Sense' in Rationing

WASHINGTON—OPA Henderson and Gov. Jones of Louisiana have locked horns over gasoline rationing.

The verbal battle started when Gov. Jones wrote U. S. Goodman, OPA Administrator for Louisiana, saying "now that the eastern interests have imposed gasoline rationing in the states of plentiful gasoline it is up to us to make the best of a bad situation until the bureaucrats see fit to relax the harsh regulation."

He appealed to Mr. Goodman to use his discretionary authority, and to ask local boards to give war workers, salesmen and those engaged in essential work the benefit of every doubt.

Gov. Jones assailed the OPA rationing system, said it had "miserably failed" in the East, and was "impossible" to apply in Louisiana.

"So my appeal to you," he told Mr. Goodman, "is to insert, in practice, the common sense that Washington failed to insert in the regulations."

To Carry On the Fight

Meantime, he said he would carry on the fight to have the regulations "either abolished or modified to a point where they are sensible and reasonable."

Gov. Jones said Louisiana has a greater percentage of her population working for the war than any other state and, therefore, should be entitled to a greater per capita gasoline allowance than any other state.

Mr. Goodman referred the Louisiana governor's letter to Washington where OPA Chief Henderson wrote a bitterly-worded reply. He said the "plain purpose" of Gov. Jones' letter was to influence local boards "to omit the careful balancing of interests required by the regulations, and to issue gasoline coupons where the particular facts may not justify the action."

Henderson Appeals to Louisianans

Mr. Henderson hoped the "good people of Louisiana" would "reject in anger" their governor's "attempt to undermine and destroy the administration of measures which their government has determined to be essential to victory."

He denied nationwide rationing was imposed by "eastern interests," claimed "gasoline rationing in the East has proven beyond question a successful means of saving rubber."

"Your assertion," Mr. Henderson charged, "that the situation in Louisiana is so different from that of the eastern rationed area as to render the Eastern solution 'impossible' for Louisiana is arrant nonsense."

He said further the governor's letter "constitutes direct encouragement to violation of the regulations."

Gov. Jones' letter was dated Dec. 1. Mr. Henderson's, Jan. 2. The two were made public Jan. 5 by OPA.

WAR ORDERS for the OIL INDUSTRY

Every care is taken each week to list every order, rule and regulation issued by any war agency and applicable to all branches of the oil industry. Since these orders are so numerous, however, we will appreciate our readers' cooperation in letting us know when they feel that we have omitted a regulation.

Complete copies of the official text of every order on oil can be obtained from PLATT'S OIL-Law-GRAM, 1213 W. Third St., Cleveland, Ohio, a publication which reproduces and mails out the orders on oil immediately upon issuance. Minimum charge for single copies, $1, postage paid. One year's service, $75.

Code: AO—Administrative order; RO—Ration order; L—Limitation order; M—Conservation order; P—Preference rating order; PS—Price schedule; RPS—Revised price schedule; MPR—Maximum price regulation; GMPR—General maximum price regulation; Supp.—Supplementary; Reg.—Regulation; GO—General order.

The Week's Orders

(Orders issued from Dec. 28-Jan. 2, inclusive)

PAW—Petroleum Administration for War
- POA 1—Supply
- Dir. 62—Credit cards

RO—Ration Orders
- 2A—Automobiles
- 5C—Gasoline
- 11—Fuel oil

RPS—Revised Price Schedules
- 56—Reclaimed rubber
- 88—Petroleum prices

MPR—Maximum Price Regulations
- 137—Retail petroleum prices
- 220—Rubber substitutes

GMPR—General Maximum Price Regulation
- Supp. Reg. 1—Aviation gasoline, rubber
- Supp. Reg. 11—Synthetic rubber

WPB—War Production Board
- Reg. 3—Priorities, rush orders
- L-31—Natural gas
- L-174—Manufactured gas
- P-98-b—Preference ratings
- P-98-c—Frozen materials

DSC—Defense Supplies Corporation
- Reg. 1—Compensation

ODT—Office of Defense Transportation
- 7—Tank cars
- 18—Carload shipments
- 21—Tire inspection

OPA—Office of Price Administration
- GO 42—Rationing

Digest of Week's War Oil Orders

PAW—Petroleum Administration for War

CREDIT CARDS—Dir. 62—Use prohibited for gasoline purchases after Jan. 1, except for commercial and government rations which can be obtained until Feb. 1 on credit cards; Pet. Dir. 62; issued 12/29, effective 1/1.

SUPPLY—PAO 1—List of preferred users of fuel oil and gasoline listed; Interpretation 1 to PAO 1; issued 12/24.

Quotas for District 1 suppliers issued for January; Am. 2 to PAO 1; issued 12/30, effective 1/1.

OPA—Office of Price Administration

AVIATION GASOLINE—RPS 88—Price control exemption widened to include 87 octane and higher; Am. 52 to RPS 88; issued 12/29, effective 1/4.

GMPR—Aviation gasolines of 87 octane rating and higher exempted from price control of GMPR also; Am. 47 to Supp. Reg. 1, GMPR; issued 12/29, effective 1/4.

AUTOMOBILES—RO 2A—1942 models priced over $2500, convertibles and 1941 or earlier models which have gone less than 1000 miles released for sale to war workers; Am. 21 to RO 2A; issued 12/30, effective 1/5.

DRY GAS—RPS 88—Maximum prices moved from Oct. 1, 1941 to May 1, 1942 level; Am. 51 to RPS 88; issued 12/28, effective 1/2.

FUEL OIL PRICES—RPS 88—Prices in rationed area raised .3c per gal.; Am. 53 to RPS 88; issued and effective 12/29.

Maximum dollar and cents prices set for distillates in Boston area; Am. 54 to RPS 88; issued and effective 12/29.

MPR 137—Retail fuel oil prices raised 0.3c per gal. to conform with Am. 53 to RPS 88; Am. 15 to MPR 137; issued and effective 12/29.

Retail price for distillates in Boston area set at 12c per gal.; Am. 16 to MPR 137; issued and effective 12/29.

FUEL OIL RATIONING—RO 11—Unit value of third period coupon raised to 11 gal. in 13 Mid-West states; Am. 1 to Supp. 1 to RO 11; issued and effective 12/24.

First valid date for third period heating coupons moved back to Dec. 28 in East and Dec. 23 in Mid-West; Am. 18 to RO 11; issued and effective 12/24.

Interim relief provisions revoked since starting date for third heating period was moved back; Am. 19 to RO 11; issued 12/28, effective 12/23 and 12/28.

Industrial users of over 100,000 gal. of distillates may use delivery receipts instead of ration coupons; Am. 20 to RO 11; issued 1/2, effective 1/8.

GASOLINE—RO 5C—Temporary transport rations to be issued for mileage required through Jan. 31, based on applicant's own estimate if he claims Certificate of War Necessity allows insufficient gallonage; Am. 7 to RO 5C; issued 12/26, effective 12/31.

Preferred mileage classification granted to Selective Service Board members, newspaper distributors, radio technicians, social workers, jurors and telephone directory distributors; Am. 8 to RO 5C; issued 12/26, effective 1/2.

PRICES—RPS 88—Bidders on government contracts may submit a price as high as the highest maximum price of any of those bidding; Am. 55 to RPS 88; issued 1/2, effective 1/7.

RATIONING—GO 42—Regional administrators in Regions 1, 2 and 4 may issue suspensions for violations of RO 5A or 5C; GO 42; issued and effective 12/24.

RUBBER, BALATA—GMPR—Sales by Rubber Reserve Co. exempted from price control; Am. 48 to Supp. Reg. 1, GMPR; issued 12/31, effective 12/19.

RUBBER, RECLAIMED—RPS 56—All sales of reclaimed rubber, except that made from scrap containing synthetic rubber, brought under same price regulation; Am. 2 to RPS 56; issued 12/31, effective 1/6.

RUBBER SUBSTITUTES—MPR 220—Maximum prices set for articles made from rubber substitutes, including bicycle tires and tubes; tire covers, topping and winter fronts; tire repair materials; and air bags and curing tubes used in vulcanizing tires and repairing tubes; Am. 2 to MPR 220; issued 12/29, effective 1/4.

RUBBER, SYNTHETIC—GMPR—The term "synthetic rubber" was clarified for exemption from price control; Am. 11 to Revised Supp. Reg. 11, GMPR, issued 12/31; effective 1/6.

DSC—Defense Supplies Corporation

COMPENSATION—Reg. 1—Oil companies to be reimbursed for intransit handling charges incident to getting compensable products to East Coast; Am. 1 to Reg. 1; issued 12/14*, effective 8/1/42.

"Wholesale price" clarified; Am. 2 to Reg. 1; issued 12/21*, effective 8/1/42.

*Not released on date of issuance.

WPB—War Production Board

FROZEN MATERIALS—P-98-c—Supply houses permitted to act as brokers in sales between operators; order continued effective indefinitely; Am. 1 to P-98-c, issued 12/31.

GAS, NATURAL AND MANUFACTURED—L-31, L-174—Consumers may be cut off from gas supply if they fail to use whatever standby equipment they have; Natural—L-31, as amended Jan. 1; Manufactured—L-174, as amended Jan. 1.

PREFERENCE RATINGS—P-98-b—AA-2X rating assigned to oil industry; laboratory equipment materials included in order; P-98-b, as amended Dec. 31.

PRIORITIES—Reg. 3—Regulations set for rush orders by telephone and telegraph; Priorities Reg. 3 as amended Dec. 26.

ODT—Office of Defense Transportation

CARLOAD SHIPMENTS—GO 18—Loading requirements set for gas cylinders, paints, varnishes and lacquers; Special Direction ODT 18, Revised-5, issued 12/31, effective 1/4.

TANK CARS—GO 7—East Coast tank car service frozen; Gen. Assignment Order 7, Revised-1; issued and effective 12/29.

TIRE INSPECTION—GO 21—Fleet operators exempt from maintaining record of tire inspections of any particular fleet unit on reverse side of Certificate of War Necessity; Exemption Order 21-3; issued 12/28, effective 1/1.

Official Text of Important Orders

PAW Lists "Preferred Consumers" Under New Quota System

(Issued Dec. 24)

TITLE 32—NATIONAL DEFENSE
Chapter XIII—Petroleum Administration for War
Part 1545—Petroleum Supply
Interpretation No. 1 of Petroleum Administrative Order No. 1, as Amended

The following official interpretation is hereby issued by the Deputy Petroleum Administrator with respect to Section 1545.1, Petroleum Administrative Order No. 1, issued December 21, 1942, as amended:

The categories listed on Schedule B include, without limitation as to other services properly coming within such categories, the following war production and essential civilian services:

(a) **Fuel Oil Consuming Services.**

(1) Fire and police stations, post offices, courthouses, schools, hospitals, and prisons.

(2) Public transportation services:

(i) Urban, suburban, and interurban common or contract carriers of passengers or freight, including terminals, and including taxicabs.

(ii) Railways, terminals, and related facilities.

(iii) Shipping on inland waterways including locks and terminals and not including dredging.

(iv) Airports and airfields.

(v) Oil pipe lines and pumping stations.

(vi) Maintenance and repair yards or shops used exclusively for the maintenance or repair of the above transportation services.

(3) Public communications services:

(i) Post Offices.

(ii) Radio broadcasting and communication.

(iii) Telephone and telegraph systems.

(4) Water supply and sanitation systems, including water works, pumping stations, and facilities for the maintenance and repair thereof.

(5) Public eating establishments, excluding places of amusement.

(6) Bakeries, dairies, and food preservation and packing plants.

(7) Establishments used principally for residential purposes.

(8) Ice manufacturing plants.

(9) Laundries.

(10) Scientific testing and research laboratories.

(11) Repair yards, to the extent that they are used for the maintenance or repair of transportation equipment.

(12) Industrial plants, to the extent that they are engaged in the production or processing of the following munitions, equipment, or material:

(i) Airplanes, airplane engines, and parts.

(ii) Naval and merchant ships and parts.

(iii) Ordnance items, including guns, ammunition, explosive, combat and military vehicles, radio equipment and parts.

(iv) Copper, brass, tin, lead, magnesium, aluminum and alumina, zinc, manganese, mercury, nickel, cadmium or monel metal.

(v) Abrasives.

(vi) Graphite electrodes.

(vii) Forgings.

(viii) The following machinery and equipment:

Power boilers, Searchlights, Electric measuring instruments, Generators, Transformers, electrical control and switchboard apparatus, Heat exchangers, Pressure vessels, Wire and cable, Steam engines, Steam turbines, Diesel engines, Gas engines, Track-laying tractors, Mining machinery and equipment, Machine tools, Machine tool accessories and machinists precision tools, Pumps and compressors, Conveyors and conveying equipment, Industrial cars and trucks, In-

dustrial blowers, exhaust and ventilating fans, Mechanical testing equipment, Ball and roller bearings and parts, Mechanical power transmission equipment, Water purification equipment, Locomotives and railroad cars, Navigation instruments, Surgical, medical and dental equipment and supplies, Optical instruments and lenses, Construction machinery and equipment.

(ix) Iron ore, pig iron, steel ferroalloys.
(x) Sulphuric acid.
(xi) Liquid oxygen.
(xii) Rubber.
(xiii) Alcohol.

(13) Public utilities, including the production, generation, transmission or distribution of electric power, natural gas, or manufactured gas for general use by the public.

(b) Gasoline Consuming Services.

(1) The operation of vehicles or equipment employed in connection with *and* essential to the services listed in paragraphs (1), (2), (3), (4), (6), (8), (9), (10), (11), (12), and (13) of part (a) hereof.

(2) The operation of vehicles employed by an executive, technician, office worker, or other employee for necessary travel to, from, within, or between the establishments or facilities listed in paragraph (12) of part (a) hereof.

(3) Transportation of farm products and necessary supplies between a farm and a wholesale or retail establishment, a public market, a shipping point, or another farm.

(4) The operation of vehicles employed by physicians, nurses, and veterinarians for making necessary professional calls.

(5) The operation of vehicles employed by a practicing minister or religious practitioner of any religious faith who regularly serves a congregation or organized religious faith to the extent necessary to enable him to meet the religious needs of the locality which he regularly serves or to render services of a religious nature.

(6) The operation of commercial vehicles except those engaged in making home deliveries other than deliveries of food, fuel, ice, or medical products.

(7) The operation of vehicles employed by engineers, architects, technicians, construction workers, repair and maintenance men, or other essential workers who require the use of such vehicles in connection with construction work related to the construction of industrial plants or facilities for the production of the munitions, equipment, or material specified in paragraph (12) or part (a) hereof, or the construction of naval or military establishments or facilities.

(E.O. 9276, 7 F.R. 10091; E.O. 9125, 7 F.R. 2719; Sec. 2(a), Pub. Law 671, 76th Cong., as amended by Pub. Laws 89 and 507, 77th Cong.)

Issued this 24th day of December, 1942.

(Sgd) Ralph K. Davies
Deputy Petroleum
Administrator for War

WPB Gives PAW Control Of M-68 Order

WASHINGTON — PAW's new total control over M-68 clears the way for selective drilling, in the opinion of well informed sources, although simplification of priorities procedure also was an objective of WPB's move in giving PAW authority to amend, extend or revoke M-68.

The amendment, No. 6, was issued Jan. 4. It was pointed out that PAW heretofore has had virtually the same authority, although it had to send its amendments through WPB. A WPB official said the latter step would be eliminated, and changes would originate and terminate right in PAW.

Unitization of drilling areas was not viewed by an official source as a prime objective of the change, but selective drilling was.

Selective drilling has been under study ever since last May and has continually looked as though an order putting it in effect was on the verge of issuance.

OPA Sets Structure For Fuel Oil Prices In Boston Area

WASHINGTON — OPA has established a price structure, with specific maximum prices for 6 distribution levels, for the sale of kerosine, No. 1 fuel oil and range oil in the Boston metropolitan area.

This is the first time that OPA has set up a dollars-and-cents structure of maximum prices. It is part of OPA's program to "spell out" specific prices for each marketing area. Fuel oil price structure in New York City will probably be the next taken care of.

In the Boston order, the principal changes from maximum prices as determined under Price Schedule 88 were advancing the yard (peddlers') price by 0.2c, recognition of a 0.25c differential for barge deliveries, and a 1c differential for deliveries of less than 25 gal. These and other changes were covered in Amendment 54 to Schedule 88. In addition, Amendment 16 to Maximum Price Schedule 137 advanced retail prices at service stations and other retail establishments to preserve a 2.5c margin for such resellers.

Specific Prices Listed

These new maximum prices for the Boston area were made effective as of Dec. 29. However, they do *not* reflect the 0.3c advance in tank wagon and retail prices on all grades of fuel oil in the 30 rationed states, effective on Dec. 29 (see story elsewhere in this issue re 0.3c advance authorized in Amendment 53 to No. 88 and Amendment 15 to No. 137).

Following are the dollars-and-cents specific maximum prices for kerosine, No. 1 fuel oil and range oil in the Boston area:

Type of Delivery	Cents per gallon
F.O.B. terminals in bulk lots for barge delivery	6.65
F.O.B. terminals in bulk lots for delivery by motor transport or tank car	6.9
At seller's yard for deliveries into buyer's tank wagons	7.5
°Tank wagon deliveries to resellers in quantities of 25 gal. or over	9.5
°Tank wagon deliveries to consumers in quantities of 25 gal. or over	10.0
°Tank wagon deliveries of less than 25 gal. and truck deliveries in containers in quantities of less than 25 gal.	11.0
°At service stations and other retail establishments	12.0

°To these prices, 0.3c was added by Amendment 53 to No. 88 and Amendment 15 to No. 137.

Under Schedule 88, maximum wholesale prices for kerosine in the Boston area, according to OPA, prior to the Dec. 29 order had been:

Type of Delivery	Cents per gallon
F.O.B. tanker terminals	6.9
At seller's yard for deliveries into buyer's tank wagons	7.3
Tank wagon	9.0

Towns Included in OPA Order

Towns and cities in the Boston metropolitan area covered by the Dec. 29 order setting a specific price structure are: Arlington, Belmont, Boston, Braintree, Brookline, Cambridge, Canton, Chelsea, Cohasset, Dedham, Dover, Everett, Hingham, Lexington, Lynn, Malden, Medford, Melrose, Milton, Nahant, Nedham, Newton, Quincy, Reading (but not North Reading), Revere, Saugus, Somerville, Stoneham, Swampscott, Wakefield, Waltham, Watertown, Wellesley, Weston, Westwood, Weymouth, Winchester, Winthrop and Woburn.

Salesmen Get More 'Gas' In Formal OPA Order

WASHINGTON — Plans to give travelling salesmen—except those in the East who will be precluded because of the gasoline shortage—enough gasoline for 65% of their last year's mileage or 8600 miles a year, whichever is less, have been formalized in Amendment 9 to Ration Order 5C, effective Jan. 8, OPA announced today.

To qualify, OPA said, a salesman must have been engaged principally in an eligible sales activity for the last 3 months or he must be taking the place of a salesman who was so engaged, and he must meet the OPA requirements on ride-sharing or lack alternative means of transportation.

List Eligibles

Eligible salesmen, OPA added, include:

1. Those primarily engaged in filling necessary materials or necessary equipment for naval, military or hospital establishments or facilities, common carriers, public utilities, industrial, extractive or agricultural establishments essential to the war effort, "or any other of the establishments or facilities listed as essential in the gasoline rationing regulations".

2. Those engaged principally in selling foods, building materials, clothing, fuels and medical supplies essential to public health and safety, except salesmen selling direct to consumers for personal, family or household use.

The allowed mileage, which will have a monthly ceiling of 717 miles based on 15 miles to the gallon, will be issued in the form of "C" rations, OPA said.

OPA Allows 'Gas' Price Hike In Quincy, Illinois

WASHINGTON — Marketers in Quincy, Ill., caught with a price war on when OPA froze gasoline price ceilings, have at last obtained relief.

Effective Jan. 9, OPA has approved 1.5c advance in retail ceilings for regular and premium grades and has set specific tank wagon price ceilings which (except for consumer tank wagon) are 1.5c above what OPA reports was prevailing tank wagon ceilings in October, 1941, the freeze date.

Following are the specific tank wagon prices by OPA, effective Jan. 9, as compared with reported prices for October, 1941.

Grade	October, 1941	Jan. 9, 1943
Regular, dealer tank wagon	7.9c	9.4c
Regular, consumer tank wagon	8.9c	10.9c
Premium, dealer tank wagon	9.4c	10.9c

OPA Eases 'Ceilings' On Government Bids

WASHINGTON — Irrespective of its maximum price for petroleum products, an oil company may enter a bid for federal, state or local government contracts based on its own ceiling price or the maximum price of any competitive bidder, but the actual sale may not be made at a price higher than the highest maximum price of any bidder, OPA ruled Jan. 2.

Amendment 55 to Price Schedule 88, effective Jan. 7, said a company selling petroleum products may charge, pursuant to open and public bidding, to any governmental agency either at his own ceiling or the highest maximum price established under Price Schedule 88 for any person participating in the particular bidding for sale of the same product to the same buyer. The amendment said no bid at such bidding, regardless of the amount, shall be deemed to conflict with any provision of Price Schedule 88.

To 'Encourage' Bidding

OPA said the amendment was designed to encourage more companies to bid for federal, state and local contracts.

"In effect," said the OPA announcement, "a dealer now may enter any bid he may determine, but the sale may not be made at a price higher than the highest maximum price of any bidder.

"Government agencies have found that dealers in petroleum products whose maximum prices are substantially below those of other parties interested in bidding for government contracts are disinclined to enter the competition. Often this disinclination is due to abnormally low bids at a time when volume and not profit primarily motivated the offer for government business . . . .

Can Bid Regardless of Ceiling

"OPA's provision seeks to remedy such inequities by according to each bidder an equal status in relation to maximum price regulation. Bids in excess of established maximum prices for the individual dealer shall not be deemed to conflict with provisions of the maximum price schedule of the product.

"Since participants in such bidding will not be known to one another, it will be impossible for an interested person to determine in advance the maximum price of others. To avoid confusion in this respect and to facilitate the operation of the new provisioin, the bid as distinguished from the sale itself is permitted to be made without regard to the maximum price established by the schedule."

OPA Warns of Jan. 31 Deadline As Tire Inspections Lag

WASHINGTON—Tire inspections are behind schedule, OPA reported Jan. 4. The agency pointed out Jan. 31 is the deadline for tire inspections and motorists had better have their tires inspected before that date if they want to keep their cars in operation since neither gasoline nor tire rations will be issued to those who do not meet the inspection deadline.

OPA said only about one-fourth of the nation's vehicles had tires inspected during December, the first month in the 2-month inspection period. On an elapsed time basis, OPA added, half of the inspections should have been completed in December.

Either Redeem Coupon Credit Notes Or Face Suspension of Rations

WASHINGTON—Consumers who fail to redeem coupon credit notes given fuel dealers before ration coupons were issued face suspension of their rations, OPA warned Jan. 4 as it set up machinery to compensate dealers, with coupons, who have difficulty with these "holdouts".

OPA said it would issue a formal order soon to do the following things:

1. Have dealers and suppliers report on Jan. 14, 15, and 16 to the local board the unredeemed coupon credit notes they hold, and the board will issue exchange certificates which can be used to replenish fuel oil supplies.

2. Dealer or supplier must give name and address of consumer and submit the consumer's unredeemed coupon notes.

3. Secondary suppliers are to report to dealer's local board on Jan. 22 and 23 if dealer has not redeemed his coupon credit. Default of coupon credit by secondary supplier is to be reported to local board on Jan. 29 or 30.

OPA said it would write consumers who have not redeemed their credit notes, and ask them to do so. "If the consumer fails to redeem promptly," OPA said, "the suspension of the individual's ration may be ordered and the entire ration recalled."

More Severe Rationing in 1943 Seen as Possibility by Ickes

WASHINGTON — Looking down the road at 1943, Administrator Ickes sees continued—and perhaps more severe—rationing of gasoline and fuel oil, and greater demands for the oil industry's specialized products.

Mr. Ickes opened his Jan. 1 forecast statement with the assertion: "New and greater problems of petroleum supply are in prospect for 1943."

The military, he said, must and will be served when they need oil, where they need oil.

"I see no prospect of any relaxation of ration restrictions in 1943," he declared. "So long as there is a rubber problem, so long will there be rationing of gasoline. So long as we have a transportation problem on the Atlantic Seaboard, so long also will we have to continue to ration our supplies of fuel oil. It may well be that conditions will get much worse before they get better; that the cuts already made will have to be deepened."

He urged motorists everywhere to hold gasoline consumption to the absolute minimum.

Nelson Hints Greater Curtail In Automobile Travel

WASHINGTON—WPB Chairman Nelson says that "travel by automobile is due for restriction much more drastic than that obtaining today".

He made this statement in a letter to Chairman Patman of the House Small Business committee, released Dec. 31.

"Travel by common carrier," Nelson also declared, "will be increasingly inconvenient and in many instances not permissible." Need for conserving gasoline, rubber and automobiles, he pointed out, has restricted the buying area of housewives and promises a comeback for the small neighborhood merchant.

PAW To Discuss Joint Use With Marketing Chairmen

WASHINGTON—Joint use of facilities and supplies program is expected to get "rolling" within the next few days with the arrival here on Jan. 5 of PAW district marketing directors, chairmen of the 5 district joint use marketing subcommittees and chairmen of the 5 marketing committees. They will meet with R. T. Collier, PAW's marketing division director, and members of his staff.

To Correlate Data

Object of the meeting, it was said, will be to clarify and correlate all information and surveys which have been made in each of the districts on joint use to date so that there will be uniform thinking throughout the country on the projected program. Complete surveys have been made in all districts on the possibilities of joint use of marketing facilities, including supplies and distribution, one official said, but no specific recommendations have as yet been made to Deputy Administrator Davies.

Chairmen of the marketing subcommittees on joint use for each district are: District 1—R. J. Hull (Cities Service) New York; District 2—E. G. Underwood (Skelly) Kansas City; District 3—E. J. Dorgan (Pan-American) New Orleans; District 4—C. W. Theal (Texaco) Denver; and District 5—W. H. Cotrel (Texaco) Los Angeles.

New Louisiana Synthetic Rubber Plant To Be Run by Copolymer Corp.

WASHINGTON—Rubber Reserve Co. has contacted with the Copolymer Corp.—formed by 7 rubber companies for operation of a new government-owned rubber plant to be built in Louisiana by Defense Plant Corp., Federal Loan administrator Jones announced Dec. 30.

The companies owning Copolymer Corp. are Armstrong Rubber Co., Dayton Rubber Mfg. Co., Gates Rubber Co., Lake Shore Tire and Rubber Co., Mansfield Tire and Rubber Co., Pennsylvania Rubber Co., and Sears Roebuck.

The EDITOR'S Page

Readers comments and opinions will be much appreciated by—WARREN C. PLATT, NPN's Editor and publisher, Penton Building, Cleveland, O.

As Government Allows Oil Better Prices Keep Telling Public and Congress WHY

IT LOOKS, at last, as if the "power that be" at Washington now realize that the great problem before the country and before the oil industry is that of supplying enough petroleum products at the right time and at the proper places to win this war.

It looks like these high authorities are beginning to realize that while this country has a lot of petroleum and much refining capacity, the oil industry cannot get more oil out of the ground, or more new and specially-refined war products from its refineries, or provide the facilities properly to distribute these for war purposes, just overnight.

And it does begin to appear that these same high Washington authorities now appreciate that this war objective cannot be achieved with oil if the oil industry is turned over to the professors and economists and other reformers to cut and fit to their own socialistic patterns.

With the swiftly growing increase in number and size of airplanes, of ships for war and ships for war supplies and for transport, to say nothing of materials for synthetic rubber and explosives, oil men have long realized that the industry's task is not only getting more complicated but much larger each day. These oil men and members of PAW also have become increasingly alarmed at the failure of higher-ups to open their minds to these pressing and menacing facts.

But at last it seems as if this new realization has come to Washington: the war cannot be won without oil products. This "new day" probably began with the appointment of ex-Justice Byrnes as "assistant president", with the rebellion of Congress that brought the firing of "OPA" Henderson, with the appointment of a man who knows the oil business as chief of OPA's oil price section —an appointment said to have been made by Roosevelt and not by Henderson—and the present activity in OPA to raise some oil price ceilings that have been holding down oil development, restricting product manufacture, and obstructing proper distribution, to say nothing of threatening the destruction of the small competitors of the major oil companies.

In the last few days have come announcements of advances in some retail and wholesale price ceilings, and a 3c dealer minimum margin with reports of early declaration of suitable jobbers' margins. In these same few days have come expressions from various officials in Washington of the need for higher crude prices, and Saturday brought the report of the Lea oil investigating sub-committee of the House which recommended higher crude prices for getting out more oil for war.

WHILE all this and more is necessary for the proper development of oil supply, the oil industry, unfortunately, will undoubtedly be attacked as now "profiteering" by the reformers, especially those that may be thrown out of OPA. Already, side remarks are coming from the "reform" section of the administration that the probable successor to Henderson, ex-Senator Brown of Michigan, is "but a tool of the interests" and that the new head of the oil price section is "only a stooge for the major oil companies" and that "inflation is now under way".

The best defense to this kind of backstairs knifing is for all concerned with oil in government and out to propose all their problems—short of strictly military ones that must be kept secret—in public; to debate those problems in public and to make frequent detailed reports to all the investigating committees that Congress may set up. Some of these investigating committees have not been fair, or intelligent, nor have they always told the truth. But at least they insure an opportunity for oil men and fair and patriotic government officials to keep the facts before the public and to write them into an official record, against future need.

Spending time explaining one's acts to these investigating committees, and using precious energy and time to prepare public statements about price changes, are all a necessary part of Democracy actually at work. Hitler, and most totalitarians, do not explain.

Those who seek to fortify the oil industry for its war job with fair prices will have to overcome the clamor of many of the OPA boys that any advance in prices is "inflation", and "profiteering" and "gouging the consumer". But that the public is better aware of our war problems than many in Washington and better aware of what has to be done to solve those problems, is indicated by this fall's election and the efforts of the new Congress to resume exercising its lawful prerogatives.

In this lies the protection of officials, of the oil industry, and of that Democracy we are fighting for.

OWI Should Get ALL the Facts

THOSE not greatly enamored of the bureaucratic reformers at Washington have been fearful that the Office of War Information — the government's official mouthpiece—would be nothing but a producer and distributor of one-sided administration propaganda.

These fears are now realized at least in one announcement. On Dec. 19th, OWI issued a special bulletin to "Victory Speakers" —whoever they are— to give them data on their speeches for "mileage rationing" of gasoline. The bulletin contains the same distorted and downright untruthful statements made by ex-Price Chief Henderson and some of his associates. The bulletin picks up the direct falsehood of Henderson's that "selfish groups have been misleading the American people". This was the slam Henderson gave to the Independent oil men, mostly in Indiana, in his Thanksgiving Day broadcast to try and save his job as the storm against him in Congress gathered more headway.

If OWI wants its official utterances believed by the American people it will have to prove to them how carefully it checks every statement and every alleged fact that is presented to it by government agencies for publication. If OWI is going to operate *ex parte* and convict the "accused" without a trial or even notice as it does with this gasoline rationing bulletin, then it will indeed be but a propaganda tool for the reformers at Washington.

We are quite certain that OWI did not consult the innocent victims of this speakers' bulletin attack. The only fair thing for OWI now to do is to recall this bulletin, and any others like it, and then get the facts from ALL interested in this recent campaign which sought to cause those at Washington connected with gasoline rationing to stop and look at some facts that they very evidently did not want to look at, in fact did not want even to know existed.

And the facts are not what Henderson and some others, and this OWI bulletin, say they are.

Are Trucks Being Crowded Off the Road?

Just Who is Actually Looking Out for Them?

ISN'T it about time that the P.I.W.C. named a special committee to try and find out just what is happening at Washington, and elsewhere, to trucks, both the trucks that the oil companies own and the trucks that the oil companies serve?

From the sidelines it would seem that trucks are rather being "pushed around", and kept by government regulation from doing the job trucks can do. If trucks are being unfairly treated, as seems rather likely, then the oil industry is interested both as owner of 120,000 of them and as supplier of fuel and lubricants and service to the other 5,000,000 or more.

The 35 m.p.h. limitation on truck speeds slows down and decreases the operating efficiency of the oil industry's own trucks and it reduces the value of the trucks in dollars and cents as customers of the industry? If the regulation is unfair there is a double reason why the oil industry as an industry should pitch into the fight to remove the unfairness.

An inquiry is being circulated by ODT today to many truck owners, asking opinions as to an order limiting length of truck hauls to 250 or 300 miles. The oil industry should have both interesting facts as well as an intelligent opinion as to whether any limitation is in the country's best interest right now. This also is a question that should immediately and greatly concern the Independent oil men and their state associations, who have used long truck hauls to compete in markets denied to them by high rail rates, or high pipe line or barge costs.

What is the oil industry, as a group, doing about the loss of its truck drivers to the draft and to other employment? The same question applies as to maintaining enough mechanics to keep trucks in repair?

Something is encroaching upon the freedom of trucks to such an extent as to cause an Army officer, in Services of Supply, to publicly state in Detroit recently that war production effort is in danger of collapse because of the handicaps that are being placed on trucks. These handicaps, he said, are hampering the inter-factory transportation on war munitions as 85% to 90% of the trucks now on the road are carrying war supplies. The statement was so important and so emphatic that the "Detroit Free-Press" put it under a streamline head on its first page.

The oil industry both directly through P.I.W.C. and through PAW and ODT, can find out just what is happening to trucks and just what it is proposed to do to trucks.

PAW, while it has no direct jurisdiction over the operation of oil trucks, nevertheless has a direct interest to see that oil trucks are properly used in behalf of the oil industry and of the consumers, PAW's responsibility for supply of petroleum products, as in furnishing gasoline and domestic heating oil to the East Coast area, is directly concerned with whether trucks should go 35 m.p.h. or 60 m.p.h., with whether they should have first or second preference for rubber, with whether more trucks and truck tanks should be made for the oil industry. In short the suggestion made last week by an Illinois agent for a large oil company, F. S. Betten of Lebanon, Ill., that a caravan of many thousands of trucks be organized in the West to rush heating oil supplies to suffering householders in the East, is one for PAW to pass on. And that suggestion immediately brings up freeing trucks from all unnecessary restrictions.

It would seem that trucks, being everybody's business have become nobody's business. Isn't it about time for P.I.W.C.—as representing both owners and suppliers to trucks—investigate?

Rationing Cuts Highway Travel

Total Reduction in Texas Hits 43.5%; Oklahoma Cut is 50.5%; and California May Suffer Revenue Cut as Much as 60%

Texas

Special to NPN

AUSTIN—Texas, the biggest war plant, war camp in America, had its highway traffic virtually whacked in half by OPA's coupon gasoline rationing during the first full week of rationing beginning Dec. 6. Total reduction was 43.5%, compared with the same week of 1941.

This is the first complete 7-day period checked by the 40 all-seeing electric eyes that keep Texas Highway Planning Survey posted on how many people are going places over the state.

The automatic counters are located at widely separated points from El Paso and Amarillo in the west to Corpus Christi and Marshall in the east. Their vigilance is constant and accurate in counting vehicles.

While the average cut in traffic was 43.5%, individual recorders varied considerably. On U. S. Route 90, 5 miles northwest of Marfa in the rugged Big Bend country, the counter showed a plus of 137.9% over the same week of 1941.

High spot in the tragic decline was on U. S. 80, 5.5 miles east of Colorado City in West Texas, where the seeing eyes counted only 6795 cars during the week while a year ago they tabulated 16,510 cars. U. S. 75, 15.1 miles north of Houston dropped 58.4%.

Other points showing 50% or more decline were near Dallas, Fort Worth, also Falfurrias, approaching the Rio Grande valley garden spot; in the eastern section, Tyler, Sulphur Springs, Humble and Nacogdoches; and in the west, El Paso, Sonora, Lampasas, Lamesa, Lubbock, Shamrock and Jacksboro.

* * *

Oklahoma

Special to NPN

OKLAHOMA CITY—Highway traffic in Oklahoma was cut 50.5% the first full week of coupon gasoline rationing. And many cars were doubtless still burning tanks of pre-ration fuel.

This proof that OPA's coupon formula already exceeds the 44% requirements of the Baruch report is found in State Highway Planning Survey's 20 official electric eye tabulators located at widely scattered points over Oklahoma.

The 20 blinkers registered 304,058 vehicles for the 7-day period last year and only 150,417 this year. The counts were taken Dec. 6 to Dec. 12 as a regular procedure of the survey. Traffic drop at the different locations varied from 12% to 67.4%, when compared with 1941. War plant areas showed the smallest decline in traffic. They were at recorder No. 4 on U. S. Highway 66, 15 miles west of Clinton, which registered the 12% drop, and No. 18 location on U. S. Highway 270, 8 miles west of McAlester, with a 13.1% drop.

Biggest tumble in the figures was at recorder 8, on U. S. 62, half mile west of Snyder in the rural section of Southwest Oklahoma where the count dropped from 8030 in 1941 to 2619 for 1942—67.4%.

Counts taken at other most important points were:

Shawnee, 4 miles east on U. S. 270—1941, 25,807 vehicles; 1942, 9908—61.6% drop.

Lawton, 8 miles north on U. S. 62-277-281—20,420 against 7511—63.2% drop.

Enid, 8 miles north on U. S. 60-64-81,—15,776 against 6347—59.8% drop.

Duncan, 4 miles north on U. S. 81—22,534 against 10,189—54.8% drop.

Durant, 6 miles north on U. S. 69-75—13,160 against 6057— 54% drop.

Oklahoma City, 8 miles north on U. S. 66-67—32,232 against 14,996—a drop of 53.5%.

Counts taken at the other points showed similar reductions, with those in the wide open spaces of farm and ranch country usually being the hardest hit.

* * *

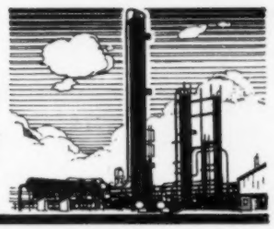
California

NPN News Bureau

LOS ANGELES—Because of gasoline rationing and the loss of federal aid funds, California in the next biennial period may be confronted with a shrinkage in state highway revenues approximating as high as 60%.

C. H. Purcell informed the State Highway Commission that in the coming fiscal year, income may be less, by $29,400,000, than the amount in the present budget.

From indicated declines in traffic and with the benefit of experience of rationing in eastern states Mr. Purcell estimated that within a few months the now rapidly declining tax revenue will be less than last year's by from 35 to 50%. He estimated that the division of highways will have for expenditure on state highways, outside of incorporated cities, the sum of $43,416,400 as compared to $72,841,500 for the same purposes in the current year.



Using Makeshift

To Overcome the Bottleneck, PAW's Max Miller Urges Refiners To Finish and Assemble Equipment in Own Shops and To Borrow from Shut Down Units

NPN News Bureau

WASHINGTON — Two ways in which building new wartime plants can aid in avoiding shortages of equipment and apparatus needed to complete their units are emphasized in the latest bulletin on Wartime Plant Design issued by Max B. Miller, chief of the equipment procurement section of PAW's refining division. They are:

1—Survey units that may be shut down or their operations curtailed because of gasoline rationing, for the purpose of "borrowing" from them instruments, control valves and other equipment that is needed for the new plant.

2—Use their own refinery shops for the finishing and assembling of equipment which can be shipped them in the rough by fabricators and manufacturers whose own shops are so rushed that these operations are delaying the delivery of badly needed equipment.

"Though many refiners have reported that temporarily they are limiting their purchases of instruments to those only which are indispensable to operation, the problem of getting sufficient instruments, control and relief valves, continues to persist," the bulletin states. "As a result of national rationing of gasoline, it would appear that many units within the refineries would either have to be shut down entirely or curtailed in their operations. We should therefore like to suggest that each refinery make a careful survey of its existing equipment with the thought that these items might be borrowed for the time being so as to complete new war plants, without the necessity of taking them away from other programs where they are badly needed.

Refinery Shops

"Some months ago when the problem in connection with the delivery of forgings became particularly acute, many refinery maintenance shops turned their attention toward the relief of this particular situation. They had forgings delivered to them in the rough which they finished in their own machine shops. They built up flanges and welding necks from mill end plate which they were able to secure from warehouses.

"The use of refinery shops in the past has been curtailed because of the lack of material, which has been so acute that the shops of the manufacturers who normally supply the refineries have not been able to operate at capacity. It is anticipated, however, that this situation will be relieved. It is suggested that each refiner who is equipped with a maintenance shop should survey the possibilities of helping out wherever possible.

"Recently the Gulf Refining Co. at Port Arthur, Tex., arranged for the delivery of unfinished heat exchangers and heat exchanger parts. The heat exchangers will be finished and assembled in their own shops. Perhaps a similar procedure might be developed in other refinery shops until such time as the delivery of heat exchangers can be more readily obtained."

The bulletin also includes a list of fabricators and manufacturers who report shop facilities in excess of those now in use and can take on work for refiners.

The bulletin also refers to the special directive recently issued by the War Production Board to expedite the flow of materials and equipment needed for the completion of approximately 20% of the authorized 100-octane gasoline plants. It states that a similar directive may be issued for the balance of the aviation plant program, unless it is found to interfere with the Army and Navy programs.

Further help in the wartime plant program will be provided, the bulletin states, through arrangements to provide the manufacturers of instruments, relief valves, heat exchangers, boilers, cast iron and steel valves and forgings with sufficient material to operate their plants at capacity for the first quarter of the year. The PAW has supplied the WPB with a complete list of the manufacturers, it was said, and the latter agency has promised to provide material for the operation of their shops at maximum capacity for this period.

The bulletin includes the emergency specifications prepared by Gulf Oil Corp. and Shell Oil Co. for the conservation of critical materials in the design and construction of their new plants. Those of the Gulf company state they have been prepared by placing the saving of critical materials above economy and by eliminating some of the precautions for safety against fire or personal injury, over and above normal requirements, which are prescribed in normal times.

Field forces are called on to pay special attention to the conservation of critical materials. "On conclusion of every job," the specifications state, "all items of critical materials shall be returned to the storehouse. No piece of pipe is too short but that it may be used for a welded connection or for foundation bolt sleeves. Scraps of reinforcing for dowels or drift pins—of mesh for use in footings, pile caps, etc., etc. The local storekeeper to decide as to the amount of such minor stocks to be maintained and to scrap the balance."

Specific limitations in the Wartime Minimum Construction Standards of Shell Oil Co. Inc., as published in the bulletin were carried in the November Technical Section of NATIONAL PETROLEUM NEWS, p. R-407.

What Is 'Fuel Oil'?

OPA Spells Out 'Specs' for Fuel Oil Covered in Previous Price Advances

NPN News Bureau

WASHINGTON—OPA has specified what oils are eligible for price advances previously authorized for distillate and residual fuel oils to offset higher transportation costs to the East Coast.

This action was taken in Amendment 57 to Revised Price Schedule 88, issued Jan. 4 to be effective Jan. 9.

Besides this, Amendment 57 also listed specific prices for Bunker C and No. 6 at several more Gulf and Atlantic ports, effective Jan. 9.

Distillate Fuels Defined

The Amendment said the 1.5c per gal. increase on distillates in the East shall apply to:

"All distillate and distillate type fuel oils having a viscosity below 85 seconds Saybolt Universal (at 100° F.) including but not limited to the following: tractor fuel, gas house oils, distillate diesel fuel oils, Nos. 2, 3, and 4 fuel oils, kerosine, range oil, No. 1 fuel oil, stand light gas oil, gas house standard light gas oil, and Mirando and Mirando-type crude oil when sold as No. 4 fuel oil or other distillate fuel oil use."

OPA Spells Out 'Residual Fuels'

The 30c per bbl. increase for residuals on East Coast, OPA said, shall apply to "All residual and residual type fuel oils having a viscosity of 85 seconds Saybolt Universal (at 100° F.) and above, including but not limited to Nos. 5 and 6 fuel oils, Bunker C, Navy grade, residual diesel fuel oils, residuum gas oil, heavy gas oil, heavy gas enrichment oil, gas house heavy fuel oil, Ne.E. gas enrichment oil, S.W. gas oil, admiralty fuel oil, Navy special fuel oil, Mirando and Mirando-type crude when sold as No. 5 or other residual fuel oil, or as a heavy gas enrichment oil."

Specific Prices Set at Several Ports

A maximum price of 85c per bbl. for No. 6 and Bunker C in cargo and barge lots f.o.b. refineries and terminals (ex lighterage) and ships bunkers, also in motor transport and tank car lots where motor transports and tank cars are used as a substitute means of transportation for tankers and barges, was set for Texas and Louisiana Gulf Coast ports including Mississippi River ports up to and including Baton Rouge. This price has prevailed at New Orleans, OPA said.

Maximum prices, for the same type of deliveries as specified for Texas and Louisiana ports, were also set as follows, OPA said:

Fall River, Mass., $1.65; Portsmouth, N. H., $1.65; New Haven, Conn., $1.65; Wilmingon, N. C., $1.65; Pensacola, Fla., $1.15; Tampa, Fla., $1.50; Miami, Fla., $1.60; and Mobile, Ala., $1.10.

Fuel Oil Price Hike Urged in Report

NPN News Bureau

WASHINGTON — Boost in price ceiling to relieve refiners of the burden put on them by "unbalancing" their production to turn out more fuel oil at the expense of better-paying gasoline was advocated by the House Oil Investigating Committee in its report issued Jan. 2.

The committee declared that "so long as refineries must operate on pre-war price ceiling determinations based on a condition in which gasoline was the money crop and fuel oil was the byproduct (which in many areas sold for less than the price of crude oil) refiners will find it difficult to survive economically."

"Crude oil has of necessity been made available to refineries on a selective allocation basis in order to assure maximum operation of those refineries making the most urgently needed war products," the report said. "The problem of overcoming this financial obstacle is most important.

"Thus, it appears the refiners are given a ceiling at prices below their cost of production. Is this a wise governmental policy? We think it is not. The citizen should bear his part of the expenses of government through taxes. To exact property below the cost of production is not a just policy and may well serve as a handicap to our war effort where it applies to critical war material. A fetish should not be made of price ceilings to stand in the way of reasonable adjustments justly due producers (refiners). This normal incentive to production should not be withdrawn from critically needed war materials. Such a policy is not only unjust but is also an unnecessary hazard to war production. A just price ceiling for crude is of even greater importance."

Jeffers Still Not Fully Satisfied With Rubber Plant Priorities

NPN News Bureau

WASHINGTON — A headlong clash between the 100-octane and synthetic rubber programs has been avoided to some extent, but Rubber Director Jeffers reportedly still is not satisfied with steps taken to clarify the relationship of the two programs.

Mr. Jeffers complained his synthetic rubber plants were not receiving materials fast enough and faced a delay because of conflicts with other programs. The 100-octane aviation gasoline program was mentioned specifically.

In the wake of his protests came a special directive from WPB from nearly 100 aviation gasoline and synthetic rubber plants—those nearest completion—and assigned "urgency numbers" to them in the order of their importance. The directive had the effect of putting these plants ahead of all other orders on the books of suppliers, if necessary, except AAA emergency ratings and other specific directions that might be issued by WPB.

An official in Mr. Jeffers' office said the rubber director was not fully satisfied with this step because it did not encompass all plants in the program. It was indicated a delay still was feared, although no definite estimate of the lag was made.

In addition to assigning urgency ratings to the projects, WPB set a completion date for each—the latest date at which the individual plant can be finished and equipped without serious trouble for the rest of the war program.

Several types of materials are specified in the directive. Each supplier, receiving an order pursuant to the directive, is required to deliver the material at a date determined by advancing the project's completion date by the number of days set forth after each item of material. The days specified for each item range from 5 to 120. Individual "special direction" is issued for each plant.

Suppliers are directed to fulfill the order even though it means interference with orders bearing a lower, equal or higher preference rating or orders placed under a similar "special direction" if it has a higher urgency number. For instance, if special directions for plants 1 and 2 come in to the same supplier, the order for plant 1 must be filled ahead of plant 2.

1942 Crude Production Dips 1%, Bureau of Mines Reports

NPN News Bureau

WASHINGTON — America's first year of war brought a 1% decline in crude petroleum, but the oil at the well was worth 3% more than in 1941.

This report, made by the Bureau of Mines, was made public Jan. 1. Crude production in 1942, the Bureau said, amounted to about 1,385,000,000 bbls., with an estimated well value of $1,620,000,000.

Total demand for all oils was approximately 1,558,000,000 bbls., a reduction of about 2% from record 1941, while motor fuel demand took a 10% nose dive, the Bureau said but pointed out that the motor fuel decrease was offset largely by 5% and 9% increases in demand for residual and distillate, respectively.

Demand for domestic crude, the Bureau estimated, was about 1,397,000,000 bbls., compared with the revised 1941 figure of 1,420,000,000 bbls., a drop of about 1.6%. Runs to stills during 1942 were estimated at 1,335,000,000 bbls.—down 5% from a year ago.

Buys E. C. Johnston's Properties

NPN News Bureau

CLEVELAND—Purchase of E. C. Johnston's producing properties, located in the Tinsley field, in Mississippi, has been confirmed by Standard Oil Co. (Ohio) officials here.

The deal included 3500 b/d and a 4000-bbl. skimming plant at Vicksburg. Purchase price was not divulged.

Harrison Oil Company Bought by Magnolia

Special to NPN

HOUSTON — In one of the most important transactions in proven oil properties in recent years, Magnolia Petroleum Co. on Dec. 30 purchased the stock of the Harrison Oil Co. here for an unofficially estimated consideration of upwards of $28,000,000. Officials of both Magnolia and Harrison declined to confirm the sale price.

The properties owned by Harrison include about half-interest in 16,200 acres of producing oil leases in Texas and Louisiana and about 80,200 acres of unproven leases in Texas, Louisiana, Alabama and Mississippi.

The producing leases acquired by Magnolia, a Socony-Vacuum subsidiary, have 163 wells with an average production of 13,040 b/d. The largest part of the properties consists of an undivided approximate half interest in about 12,000 acres of producing leases in the Old Ocean field, 70 miles from Houston. The leases to which the interest pertains in this field have 76 wells with a daily average production of 9760 bbls., the parent company announced at New York. The other half interest in the properties is held by J. S. Abercrombie Co., the Socony announcement said.

The sale was made to D. A. Little, Dallas, Magnolia's president, or his nominee. About 22,500 shares were involved.

Harrison Oil Co. was organized in 1925, starting operations in Liberty county. In addition to Old Ocean field, principal holdings included properties in Brazoria county, Conroe, Montgomery county, East Texas and the East Hackberry field, La.

Jones-Atkinson Corporation Closes; To Form 2 Separate Companies

NPN News Bureau

NEW YORK — Dissolution of the Jones-Atkinson Corp. as of Dec. 31 has been announced by Charles L. Jones and Laurence H. Atkinson. Resolution for dissolving the company was voted at a recent directors meeting.

Prior to formation of the corporation 2 years ago, Mr. Jones was a vice-president of Socony-Vacuum Oil Co. and Mr. Atkinson owned and operated the Atkinson Petroleum Co.

Both men will operate their own companies, the Chas. L. Jones Co. and the Atkinson Petroleum Co., after the first of the year. Offices will be located at 9 Rockefeller Plaza, New York City.

Refinery Explosion Kills 2 Men

NPN News Bureau

LOS ANGELES—Two workmen were killed and a third seriously burned in an explosion and fire on Dec. 28 at the Standard Oil Company of California's refinery at El Segundo.

The explosion, it is said, resulted from a vapor and oil leak at one of the cracking units of the plant. Company officials said only minor damage was done to the plant.

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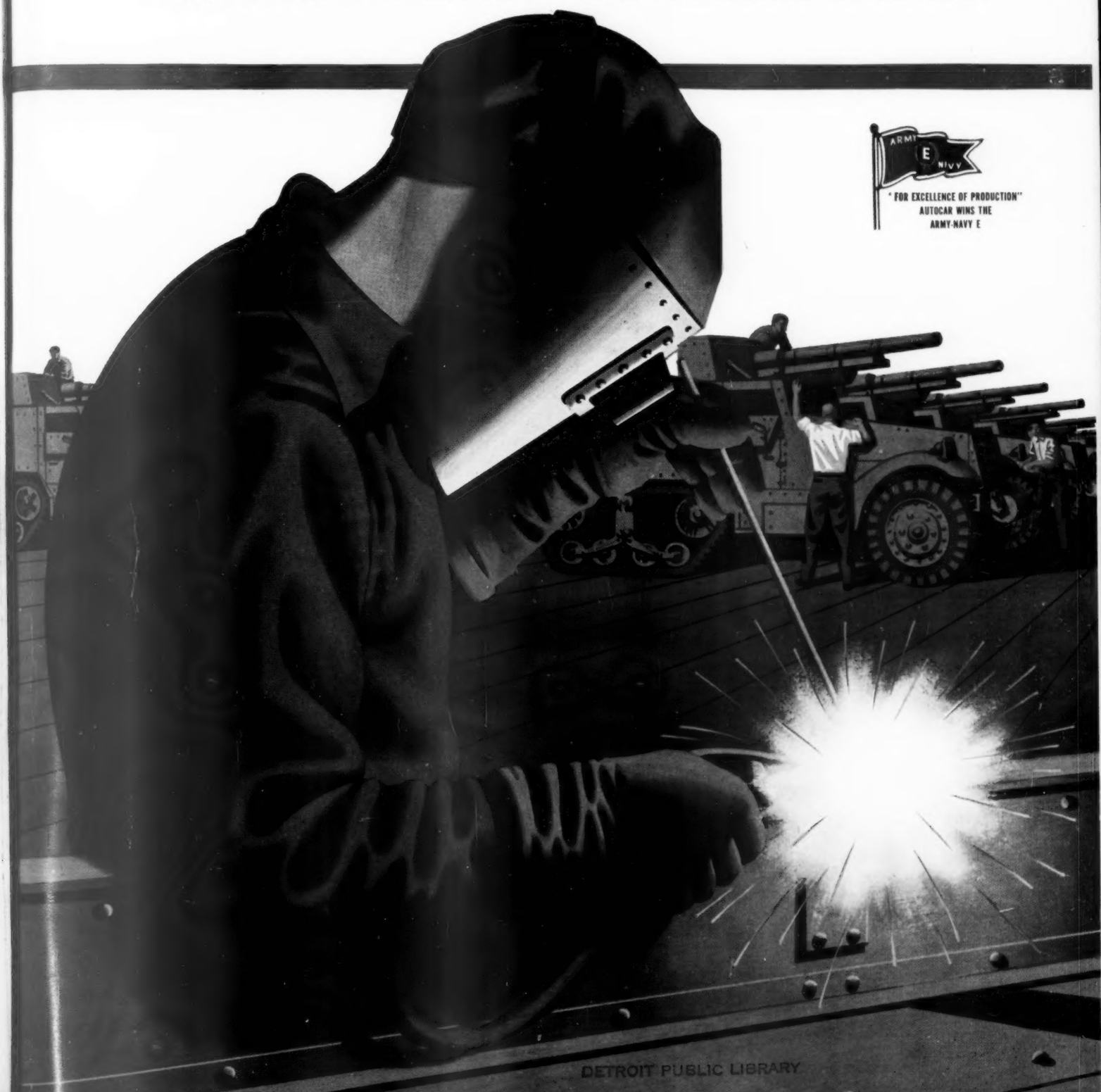

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If you are not supposed to touch that equipment, you had better stay away

Joseph S. Boylan, superintendent of Conoco's safety and sanitation division

Dogpower

Conoco Trains Man's Best Friend To Be Saboteur's Worst Enemy

An oil company president who likes dogs now sees his hobby in an important wartime plant protection role.

Seven Bullmastifis (60% mastiff and 40% bulldog) are on duty at Continental Oil Co.'s Ponca City plant, guarding against saboteurs. Breeding stock for the dogs was imported from England several years ago by Continental's President Dan Moran.

The Bullmastiffs, comprising Continental's "K9 Corps" (the Army's name for its canine soldiers) are assigned to company plant guards when they go on duty at various patrol stations at nightfall. They circle tanks and buildings, on the lookout for saboteurs, covering all the grounds in their respective areas. Should a prowler be caught, they are trained to hold him until a guard arrives.

Not Lap Pooches

These dogs are powerfully built animals with broad shoulders and tapering hindquarters. They have smooth, short, fawn-colored hair, V-shaped pendant ears, strong jaws, long swooping tails. They have friendly eyes which become serious and calculating until they distinguish between friend and foe. Weighing from 100 to 125 lbs., they follow the characteristics of their lion-fighting ancestors. Putting it mildly, they're far from being lap pooches.

Continental's K-9 Corps training period starts when the animals are 8 months old. The primary training is conducted by a circus animal trainer. The pups are taught to heel, lead, attack, follow and stand. After approximately 6 weeks basic training, advanced training is given under the company's chief patrol officer.

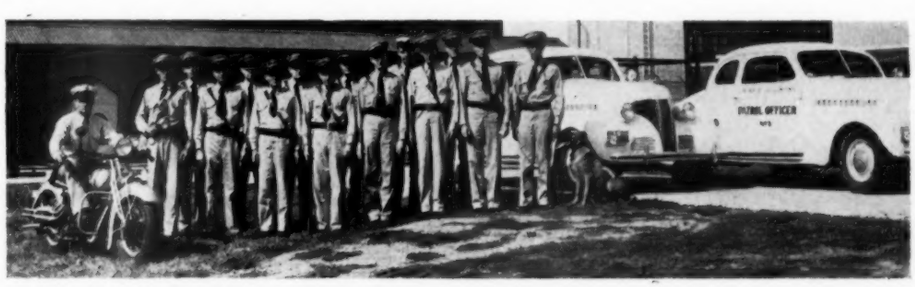
The same care and attention is given this industrial canine army as is given dogs in various allied Army commands, including the U. S., which has K-9 Corps training programs for animals similar to that conducted by Continental. Kennels designed for breeding and training sufficient dogs for all of the company's properties have been established in Ponca City.

The dogs are fed twice daily on food outlined by canine food authorities. The calories and minerals are carefully balanced. Twice weekly the meals include fresh meat, cod liver oil and cereals. The afternoon meal is light to encourage the hunting spirit.

Continental's K-9 Corps program, company officials point out, is only a part of that company's greatly expanded plant protection program.

In addition to trained, armed plant guards, gatemen are on duty at all the company plants, at all entrances. These gatemen inspect every truck entering the grounds. Those not actually employed in the plants are accompanied by armed guards.

"Lady" jumps hurdle as part of her training



Conoco's armed guard corps

Oil TRANSPORTATION

Tank Car Orders

More Are Reported Coming, Assigning Cars to Specific Services in Effort To Increase Wartime Efficiency

NPN News Bureau

WASHINGTON—ODT officials anticipate eventually assigning all of the nation's 143,000 tank cars to specific services to get the most good out of them in the way of war transportation.

The first step toward this objective was to freeze all tank cars in eastern service if they were supplying the East Coast as of Dec. 29.

Officials say they do not know when other orders will be issued to place all of the country's tank cars exclusively in one service or another, but the authority for them to make assignments of that character is clear-cut in ODT General Order 7, Revised, which was issued Dec. 12.

At the time the order was issued, ODT said it would "assign certain tank cars exclusively to the eastern petroleum service and eventually all of the nation's 143,000 cars to specific services."

Authority of Order

The order itself says:

"The Office of Defense Transportation may among other things direct that any tank car or cars be assigned to eastern petroleum service, or any other service, exclusively. No person shall load, receive, forward, or divert a tank car so assigned to any such service in or to any other service unless authorized by the Office of Defense Transportation."

Definite assignment of a tank car to some other service might mean cutting through an existing lease or other arrangement. Anticipating such a condition, the order empowers ODT to direct the use of a tank car between any points and for any purpose, "notwithstanding any contract, lease, or other commitment, express or implied."

ODT would leave the question of compensation to the interested parties to decide. Failing that, the ICC or other government authority—not specified in the order—would determine the amount of compensation.

Oil Barges Move Southward

NPN News Bureau

WASHINGTON — The barges that once hauled oil on the New York barge canal are now in service farther south.

To date, a government official said, 150 or 170 barges have left the canal to move oil around New York harbor, in the shuttle service to New England, from New York to Philadelphia and along the Hudson river.

Total capacity of the transferred barges is about 900,000 bbls.

Plan Carrying of Oil In 200 Box Cars

NPN News Bureau

WASHINGTON — Out of a White House conference with rail officials, called because of the growing seriousness of the East Coast supply situation, came the disclosure that plans are under way to rig 200 box cars with Mareng cells and solidine flexitanks to convert the cars into oil carriers.

The Mareng cell and flexitank—similar in that both are made of synthetic rubber—when placed inside box cars make them capable of holding about 12,000 gal. each.

One hundred cars would be fitted with the Mareng cell and 100 with the flexitank.

Apparently a brain child of the Assn. of American Railroads and the ODT, the program is understood to be held up while a few details are overcome. An informed source said financing is one of the obstacles to be overcome—whether the 200 cars will be financed by RFC or privately.

Take More Mid-West Cars

Without waiting for expedients like the Mareng cell to be placed in service, ODT and PAW have pulled about 500 or 600 tank cars out of automotive gasoline service in Districts 2 and 3 to supplement tank cars already bringing oil to the East.

An ODT spokesman said car owners were notified of the action which was taken under ODT's self-given authority to direct the use of rail cars.

Withdrawal of the cars was the second step taken toward specific assignment of tank cars. The first was the order freezing in eastern service all cars in that service on Dec. 29 (see story above).

Although cold weather and floods have impeded tank car shipments, breakdown of the cars also has resulted in lost time.

To correct that fault, ODT has provided for tank car repairs where they occur. All owner's repairs, except rebuilding, are to be made where the car breaks down. Payment is to be made by the owner or by the lessee, whichever the lease provides, as usual, an A.A.R. official said.

Check on 'Bad Order' Cars

Railroad officials are not satisfied with the picture they have so far of delays caused by "bad order cars". In a move to remedy the statistics now available, A.A.R. is taking a monthly spot check of railroads to find out how many cars are released on a given day from repair shops and how much time was lost by both loaded and empty cars while being repaired. The first report is being made for Dec. 31, but in the future the report will be taken as of the third Thursday of each month.

Meantime, an ODT official claimed the vegetable fats and oil traffic has not made such a big dent in eastern tank cars. He said about 7200 cars are in fats and oils trade now compared with about 10,000 at this time last year and this year's traffic is greater.

He gave the following breakdown of tank cars between services:

Service	Tank cars (Approximate)
Petroleum	110,000
Chemicals	10,000
Railroads, for their own use	10,000
Fats and oils	7,200
Alcohol and molasses	3,000
Wine (Multiple compartment)	700
Milk	400

Big Pipeline Receives First Setback As Old Man River Runs Wild

NPN News Bureau

WASHINGTON — Construction schedule of the big crude oil pipeline from Longview, Tex., to Norris City, Ill., hit its first real setback last week when rampaging flood waters swept away almost 600 ft. of pipe at the Mississippi river crossing. Total length of the crossing will be about 2400 ft., and 800 ft. had already been set in at the time of the washout.

Initial operation date of the Longview-Norris City leg will be delayed about 6 days, it is estimated, with the date now being set for Feb. 1 instead of Jan. 25 as originally.

In order to speed repairs as rapidly as possible, orders have gone out to divert heavy pipe and anchoring shipments from points along the route in Indiana and Ohio to the Mississippi river crossing point.

Time of the mishap was set at 4 a. m. on Tuesday, Dec. 22.

ODT Officially Sets January 31 As Temporary Ration Deadline

NPN News Bureau

WASHINGTON—January 31 has been officially set as the deadline for issuance of temporary transport rations for trucks, buses and other commercial vehicles needing more gasoline than the ODT War Necessity Certificate gives them.

The deadline was specified in Amendment 7 to nationwide gasoline rationing regulations which made the temporary rations available to the following cases, in addition to those previously provided for:

1. Where a previously issued temporary ration is insufficient to meet the applicant's needs through Jan. 31 and the applicant has not yet received his certificate.

2. Where a transport ration has been granted upon the basis of a certificate and ration is insufficient to fill applicant's requirements through Jan. 31, and where the appeal has not, as yet, been acted upon.

Meantime, ODT announced its central mailing office at Detroit has been closed and all matters relating to War Necessity Certificates are to be handled by the regular field force.

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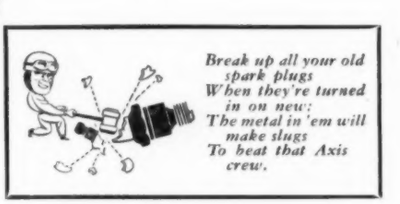


IT PAYS YOU WELL—TO STOCK AND SELL CHAMPIONS

Compensatory Plan

NPN Tells How RFC Plan for Paying Extra Transportation Costs to East Works and How Two Amendments Have Been Made To Smooth Out Rough Spots

NPN News Bureau

WASHINGTON — Let's take the case of the "John Dokes Independent Oil Co." that in ordinary times would bring its gasoline from the Gulf to the Eastern Seaboard by tanker. Now with tanker transportation "out", the gasoline comes in by hop, skips and jumps —barge, pipeline, tank car, tank truck, maybe lake tanker—via an overland route.

And the cost has shot skyhigh. He could buy some of his supplies in the Midwest, but the cost of the gasoline would be higher than on the Gulf. And from the Gulf the transportation cost would be more, naturally, than from the Mid-West.

OPA's price ceilings prevent the company from passing these on to the consumer in the ordinary course of business. But it can pass the difference between its "normal" transportation cost and its "substitute" transportation cost on to Uncle Sam by way of the Defense Supplies Corp. of the RFC.

Let's say the company buys its gasoline at Port Arthur, Tex., and brings it by barge to Port St. Joe, Fla. There it is unloaded and moved by pipeline to Chattahoochee, Ga. From there it has to be trucked to Anderson, S. C.

This is the "substitute" method of transportation. The "normal" method before the submarines became active, was to bring the gasoline by tanker from Port Arthur to Charleston and thence on to Anderson by tank car.

In computing its abnormal costs, the company first determined its transportation charges under each method on a per barrel basis.

Under the old "pool" plan, the Dokes company could buy gasoline in the Southwest for much less than in the Mid-West and recover much more from the "pool" for the long overland haul cost.

Under the RFC plan, however, is compensated for the difference between the East Coast laid-down cost, by "substitute" transportation, and the laid-down cost of Gulf Coast products is brought up by "normal" transportation.

This was well enough as far as it went, but the Dokes company was at a disadvantage—it was out of pocket as far as handling charges in transit were concerned. It used 3 transportation facilities—barge, pipeline and tank truck. Each time the gasoline was transferred from one carrier to the other there were handling costs. And there was no provision for making compensation for these in the RFC plan.

However, DSC has undertaken to streamline its compensatory plan. Two amendments (one issued Dec. 14, the other Dec. 21) cleared up some of the rough spots in the original plan and ironed out this inequality.

The Dokes company, like many others, gets a "break" under these amendments. It can now claim repayment for the difference between these in-transit handling charges and those incurred under the "normal" movement. Included in these recoverable costs are charges for terminaling, storage, loading and unloading.

Allowance is also made for any emergency shifts of gasoline the company is ordered by PAW to make from one point in District 1 to another. If the Dokes company has laid its product down at Anderson, S. C., as its destination and if later ordered by PAW to move it to Norfolk, the company can claim from DSC the added transportation cost from Anderson to Norfolk. Under the plan, PAW names the amount of the transportation compensation in its order.

Instead of filing its application for compensation with the DSC, the Dokes company now should file them with Price, Waterhouse & Co., 56 Pine Street, New York, N. Y. Before filing a claim a company should feel free, say officials of DSC, to talk their problems over with Price, Waterhouse.

Urges Cut in Tank Truck Deliveries To Many Individual 'Gas' Consumers

Special to NPN

INDIANAPOLIS—A plan designed to release tank truck drivers for work in defense industries, and at the same time save rubber and wear and tear on equipment has been suggested to Petroleum Administrator Ickes by W. H. Jarrett, Indianapolis, president of the Clipper Oil Co.

Mr. Jarrett's idea is to discontinue truck tank deliveries of gasoline to individuals, commercial accounts, trucking companies, industrial accounts, grocery stores and others who buy gasoline for their individual requirements.

He believes that truck tank and transport trucks should be used only for transporting petroleum products from terminals, refineries and bulk plants to gasoline service stations, war industries requiring petroleum products for their operation, farmers who use petroleum products for producing farm products, army camps, airports and other essential groups.

Mr. Jarrett, in a letter to Mr. Ickes on Oct. 16, pointed out that by eliminating these expensive, unnecessary, overlapping deliveries, thousands of truck drivers, many of whom are good mechanics, would be available for work in more essential positions.

Petroleum products would be bought by those forbidden delivery from the nearest service station. This in turn, Mr. Jarrett points out, would help to keep stations from closing, thus producing revenue so badly needed to meet taxes.

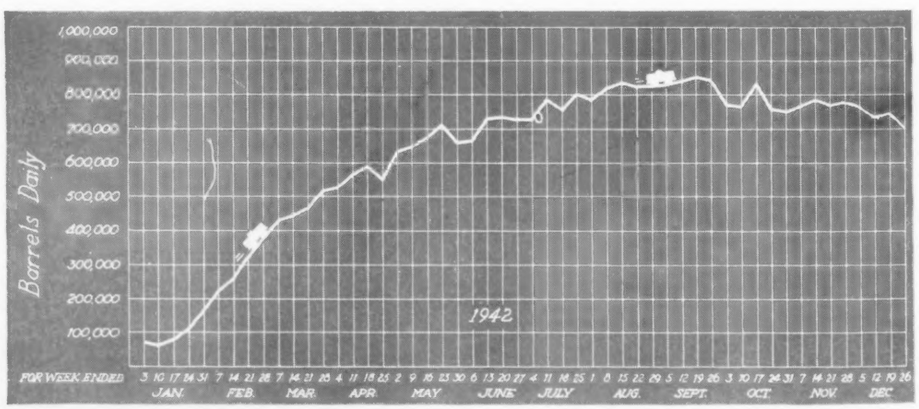
In his letter Mr. Jarrett offered the suggestion that if a survey were made, users would find a service station that could serve them promptly, efficiently, and at an equal price, within one to five blocks from their business.

Tank Car Hauls to East Drop Sharply to 700,827 b/d

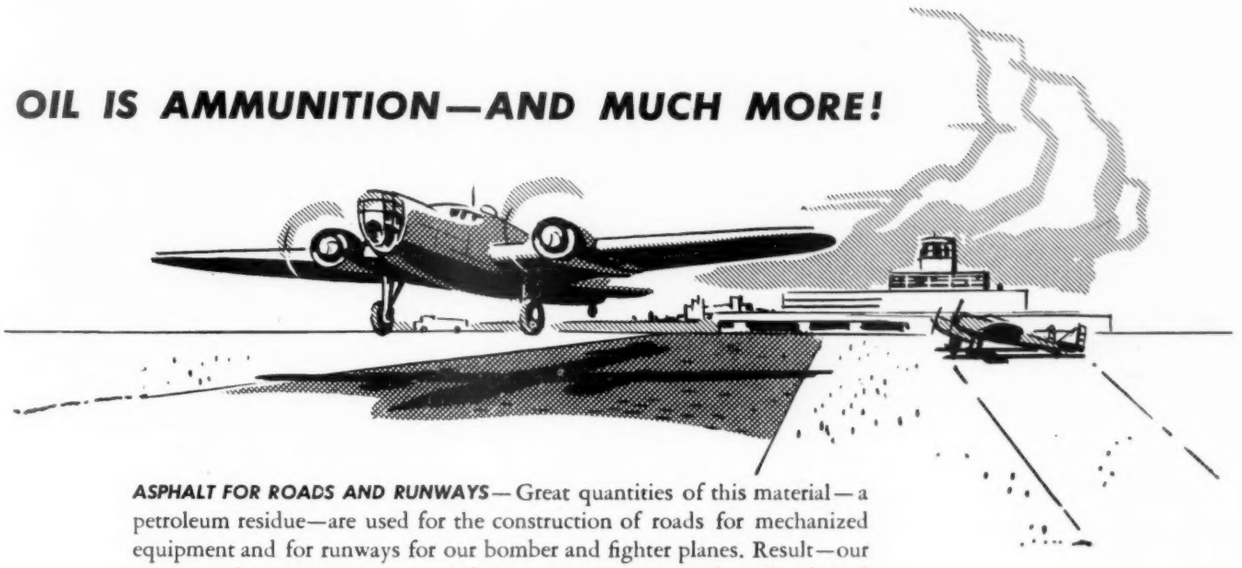
NPN News Bureau

WASHINGTON—Tank car shipments of crude and products to the East Coast dropped sharply to 700,827 b/d during week ended Dec. 26 as compared with 744,023 b/d during the previous week, PAW announced Dec. 25. Total of 38 participating oil companies loaded 22,712 tank cars broken down as follows:

Company	Cars	Company	Cars	Company	Cars
Allied	52	Daugherty Refinery	6	Shell	1,113
American Bitumuls	35	Eastern Seaboard Petroleum	8	Sinclair	2,049
Amsco	120	Gulf	1,953	Socony-Vacuum	2,529
Arkansas Fuel Oil	283	Hartol	149	Southland	15
Ashland Refining	59	National Refining	3	California Standard	21
Atlantic Refining	1,902	Pan American	1,562	Kentucky Standard	145
James B. Berry Sons	2	Petrol Corp.	255	New Jersey Standard	4,398
Canfield	1	Petroleum Heat & Power	38	Sohio	63
Canton Refining	2	Phillips	5	Sun	1,759
Chalmette	27	Pioneer Asphalt	2	Talco	47
Cities Service	1,055	Pure	166	Texaco	1,612
Conoco	343	Roosevelt	1	Tide Water	915
Crown Central	10	Royal Petroleum	7		



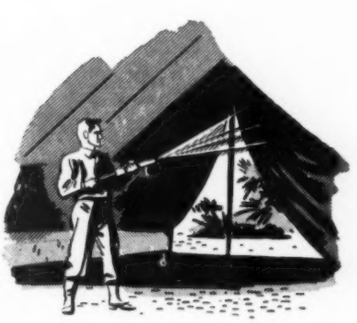
OIL IS AMMUNITION—AND MUCH MORE!



ASPHALT FOR ROADS AND RUNWAYS—Great quantities of this material—a petroleum residue—are used for the construction of roads for mechanized equipment and for runways for our bomber and fighter planes. Result—our troops and equipment can travel faster...our planes can take off and land with a higher degree of safety.

SYNTHETIC RUBBER FOR A THOUSAND USES—An extract from petroleum called butadiene is helping to make up for the stoppage of our natural rubber supply. Tires for trucks and jeeps, treads for tanks, bullet-proof linings for plane gas tanks, are among the war necessities being made from this material.

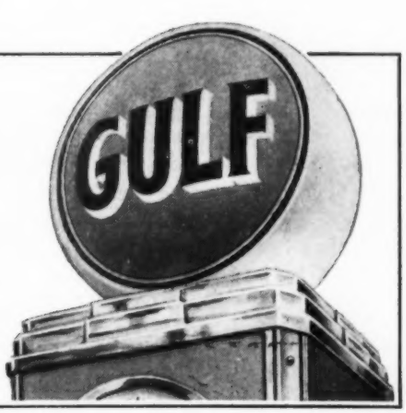
IN TIME OF WAR uncontrolled epidemics would take more lives than enemy bullets. In order to prevent disease, insecticides originally developed by the petroleum industry for use in the home are being employed by our armed forces to kill germ-carrying flies, mosquitoes, and other insects.



★ *The American petroleum industry has undertaken—and is performing—huge tasks of immense importance to our war effort. The Gulf Oil Companies take deep pride in the privilege of serving in these accomplishments.*

GULF OIL CORPORATION
GULF REFINING COMPANY

Peace Must Be Paid For—Buy War Bonds And Stamps



Truckers Gloom

Manpower, Tires, Parts and Breakdowns To Increase in 1943, ODT Says; Urges Operators Take Steps To Find Solutions to Problems

NPN News Bureau

WASHINGTON — A hard year for truckers, with scarcity of parts, tires, manpower and vehicles to be much more critical in 1943 than in the year just passed, is forecast by ODT.

In an official summary of prospects for the trucking industry this year, ODT said on Jan. 3 that "no truck owner in the United States—from the farmer or corner grocer, with a single delivery truck, to the big fleet owner—will be immune" from the multiplicity of problems.

Most operators, ODT found, are aware of the grave problems they face and are taking steps to combat labor and equipment shortages. But there are others who believe things will work out all right in the end and rely upon the coming of a miracle. To these, ODT's message was brief: "You're heading for trouble."

Problems Vary

Some operators, ODT said, will find tires their biggest problem; others will find manpower the greatest; some will have their most difficulty in the way of vehicles; others will worry over parts. Others, more unfortunate, will have their woes a combination of all four.

In 1943, the crude rubber for commercial vehicle tires will be only 45% of what it was in 1941.

Because the armed forces and war industries are draining off the truck industry's mechanics and drivers, management must do everything possible through training, upgrading of workers and employment of women to fill the gaps left by departing employees.

Parts Supply 'Tight'

Already a big headache, parts are "tight and getting tighter", ODT said, with crankshafts for certain engines, for example, already exhausted. ODT revealed it is taking steps to increase parts production in 1943, but proper lubrication and repair and rebuilding of worn parts will take a big load off the supply of critical materials and burdened factories.

ODT expects the stockpile of commercial vehicles to last through 1943. ODT said, however, the actual need for replacements is because of reduced mileage, controlled replacements, improved operating efficiency and better maintenance, as evidenced by the 800 to 900 applications received weekly for new trucks compared with 3000 a week last spring.

Truck Conservation Corps Enlists Over 3 Million

NPN News Bureau

WASHINGTON—Only continuing efforts to give every truck in the country the best possible care will make the U. S. Truck Conservation Corps a success and keep trucks running longer with as few new parts and tires as possible, according to ODT.

More than 3,000,000 decals have been passed out for imprinting on truck cabs, but the mere presence of the insignia does not mean a truck owner has fulfilled his duty to keep his truck in good condition.

ODT said on Dec. 30:

"Signing the pledge is merely the first step toward full participation in the preventive maintenance program. Nor does placing an emblem on the cab door of a truck constitute fulfillment of the obligation which the nation's truck owners are being asked to assume as a patriotic duty.

Corps Emblem Is Symbol

"The Truck Conservation Corps emblem is merely the symbol of a continuing drive to keep America's trucks rolling with as few new parts and tires as possible so that the limited supply of raw materials and the manufacturing facilities of the country may continue to be concentrated on production of guns, planes, tanks, and ships and other materials of war.

"In signing the Truck Conservation Corps pledge, the truck owner assumes a moral responsibility to prolong the life of every vehicle under his control by following certain specific procedures of modern automotive practice.

"Success of the program will depend on the extent to which those who own, drive and service the Nation's trucks cooperate in the program."

Fire Departments Sign Up

ODT's statement was issued in conjunction with the announcement that fire departments all over the country are the newest recipients of literature designed to bring them within the circle of preventive maintenance practitioners.

The U. S. Truck Conservation Corps is being explained to more than 12,000 fire departments all over the country. ODT reported that more than 2300 fire department drivers, mechanics and chiefs in 118 cities have signed the pledge already.

ODT urges oil companies to concentrate on the small truck owner, farmers in particular, in promoting preventive maintenance in connection with the U. S. Truck Conservation Corps.

Emphasizing that the U. S. Truck Conservation Corps must be a continuing campaign to keep the nation's trucks in operating condition, an official said the oil companies can do a lot of good by impressing the need for regular care upon the owners of 1, 2 and 3 trucks.

The ODT official pointed out that 88% of truck owners operate one truck, and that 33.3% of farm trucks are more than 10 years old.

Meantime, ODT officially urged truck and passenger car owners to lubricate properly.

Stress Lubrication

"Particular care should be taken to keep the vehicle properly lubricated," ODT said. "A large proportion of major assembly breakdowns are due to neglect of lubrication. Similar preventive maintenance practices—rotation of tires, periodic battery inspection, change of air cleaner bath, etc.—which can be handled by filling station attendants, should be cultivated."

The growing shortage of mechanics and replacement parts gave rise to ODT's suggestion that unessential repairs be postponed until after the war, but that essential repairs, especially mechanical jobs, be taken care of immediately.

Ohio Oil Takes Over Subsidiary, Forms New Pipeline Company

Special to NPN

FINDLAY, Ohio—Ohio Oil Co. has absorbed and dissolved its subsidiary, Illinois Pipe Line Co. as of Dec. 16, according to announcement by Ohio's President O. D. Donnell. The action was approved by Illinois Commerce Commission in an order dated Dec. 15.

Properties of the subsidiary in states of Ohio, Indiana, Illinois, Kentucky, Montana and Wyoming, including the trunk pipeline system from Wood River, Ill., eastward into Ohio and Kentucky, its gathering lines, pump stations and other appurtenances, will in the future be operated as pipeline department of the Ohio Oil Co., Mr. Donnell said.

Creates New Company

"A new pipeline company," he said, "to be known as Illinois Pipe Line Co. of Texas, has been organized under the laws of Texas, and the old Illinois Pipe Line Co. as of Dec. 15, transferred to the new organization, all properties located in the state of Texas. These properties consist principally of its West Texas gathering system in the Yates pool of Pecos county, and East Texas lines in Rusk, Smith and Cherokee counties."

Ohio Oil Co. owns all stock in the new Texas corporation, and the old Illinois Pipe Line Co. wound up its affairs as of Dec. 31, announcement stated. All employes have been transferred to Ohio Oil Co., except those in Texas, who were retained by the new corporation there.

Officers Named

Charles Bunje, Jr., formerly president of Illinois Pipe Line Co., has been elected vice-president of Ohio Oil Co. and will manage the pipeline department. O. F. Moore, vice-president and secretary, and C. H. Gompf, treasurer, respectively of the dissolved organization, are now assistant secretary and assistant treasurer of Ohio Oil.

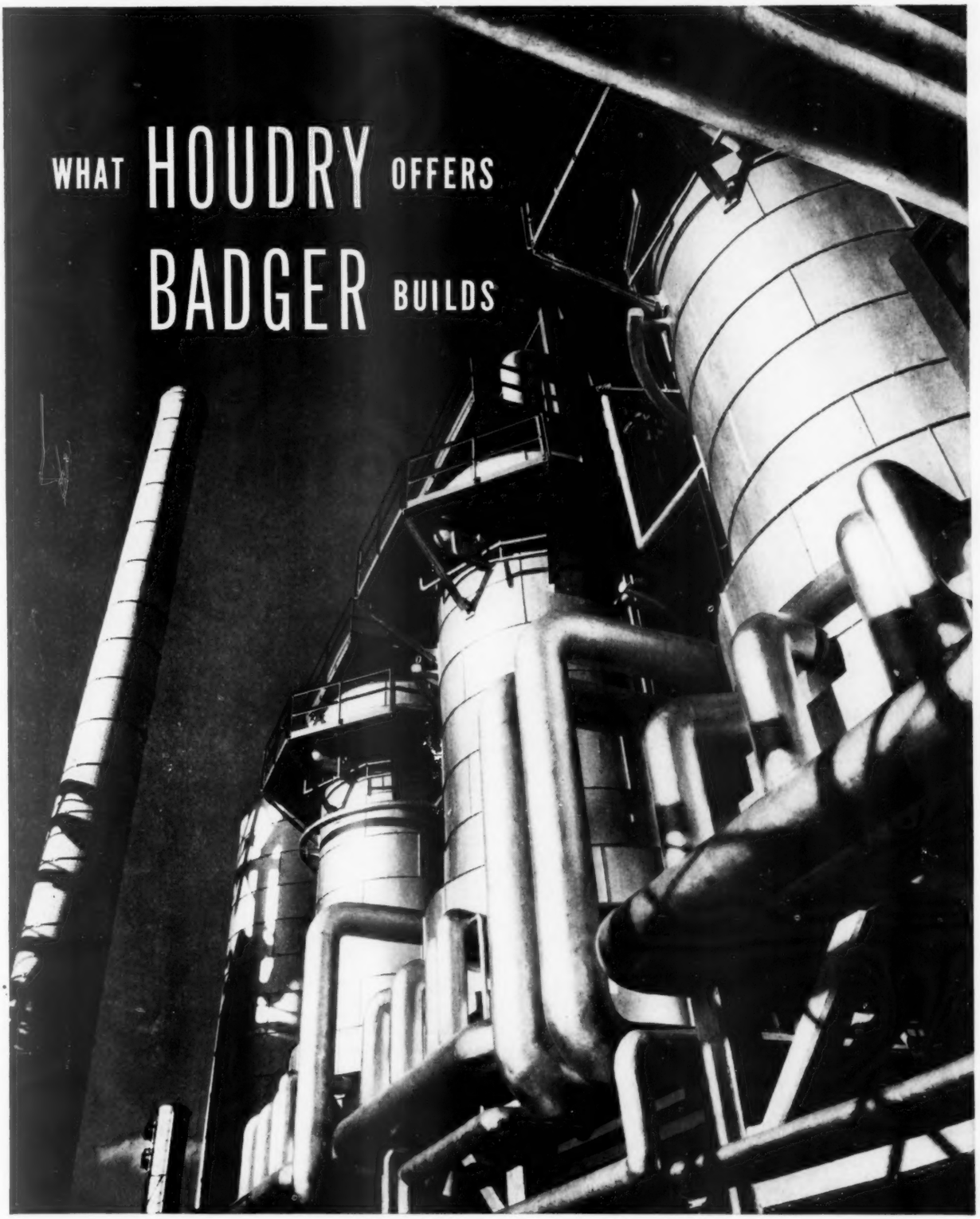
Officers of the new Illinois Pipe Line Co. of Texas are Charles Bunje, Jr., president; O. F. Moore, vice-president and secretary; C. H. Gompf, treasurer; R. N. Montgomery, vice-president and assistant treasurer; D. E. Winterrowd, assistant treasurer. Assistant secretaries are Clayton L. Orn and F. M. Carpenter. Board of directors consists of the officers and R. C. Gwilliam.

Illinois Highway Traffic Drops 20%

NPN News Bureau

CHICAGO—Since gasoline rationing went into effect on Dec. 1, highway travel in Illinois has decreased 20%, according to a report issued by Harry Yde, acting chief of the state highway police.

Mr. Yde said that the decline was uniform throughout the state.



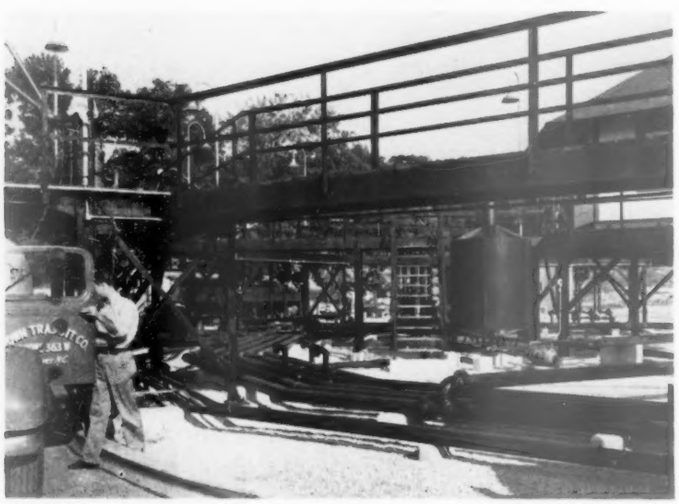
LICENSING AGENTS FOR THE HOUDRY CATALYTIC CRACKING PROCESSES

E. B. BADGER & SONS CO. BOSTON · EST. 1841

NEW YORK · PHILADELPHIA · SAN FRANCISCO · LONDON

PROCESSING ENGINEERS AND CONSTRUCTORS FOR THE PETRO-CHEMICAL INDUSTRIES

The "Christy merry-go-round" tank truck loading rack of the Chattahoochee (Atlanta) terminal of the Southeastern Pipe Line Co. Six trucks can be loaded and dispatched in 15-25 minutes. The building in the background is the warehouse



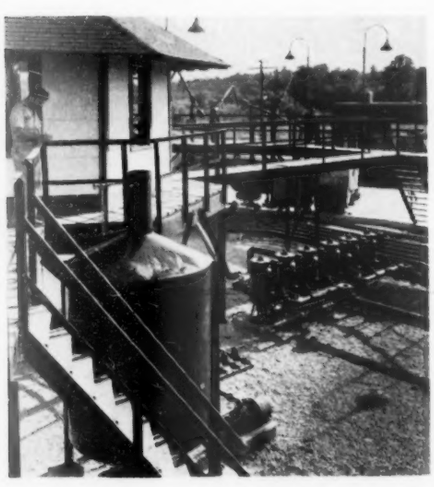
This maze of pipes and equipment is the heart of the loading rack. The large tank to the right of the steps is a 1000-gal. prover tank for testing the accuracy of the meters. Reports indicate that the meters are accurate within one-tenth of 1%, despite this extra precaution

'Merry-Go-Round' Loading Rack

Generally, the "merry-go-round" goes round and round, but in one case it's the tank trucks that pull around a new type loading rack at the Chattahoochee (Atlanta) terminal of the Southeastern Pipe Line Co., owned and operated by Pure and Gulf.

Named the "Christy merry-go-round", this is said to be the first hexagonally designed rack to be built in the U. S. Six of the largest type transport trucks can load at once, and the driveway around the rack is built wide enough to allow trucks to pass without disturbing any of the trucks being loaded.

The Southeastern pipeline has 9 terminals in all, but the Chattahoochee unit is the only one that is not of standard design. Other terminals are located at Port St. Joe, Fla., Bainbridge, Albany, Americus, Macon, Griffin, and Rome, Ga., and Chattanooga, Tenn. Each terminal,



—LEFT

Air eliminators which remove air from the lines and make accurate metering possible are shown in right center of photo. At left is the meter proving tank

RIGHT—

Close-up of the platform showing the meters with automatic ticket printers

Survival isn't enough—

DIAMOND D-X DISTRIBUTORS Have Shown Actual INCREASES Under War Conditions

Below are some of the advertising and merchandising plans, promotional ideas and educational films which are helping distributors today.

Products of Mid-Continent Petroleum Corporation

D-X AND D-X ETHYL

DIAMOND 760 MOTOR OIL — DIAMOND GREASES

HOME OIL CO.
Killduff, Iowa

September 10, 1942

Mr. G. J. Lee
Mid-Continent Petroleum Corp.
Waterloo, Iowa

Dear Mr. Lee:

We felt that we were lining up with popular products, namely: Diamond 760 Motor Oil and D-X Lubricating Motor Fuel, when we changed six years ago. However, we did not expect our sales to increase as rapidly as they did during this period. Our Light Oil sales increased 250%, and the Lubricating Oil sales about the same.

We sincerely believe the success of our business is largely due to your splendid sales suggestions and advertising programs, which have been of inestimable value to us.

Very truly yours,

HOME OIL COMPANY
H. H. Hagaman

Products of Mid-Continent Petroleum Corporation

D-X AND D-X ETHYL

DIAMOND 760 MOTOR OIL — DIAMOND GREASES

GAFILL OIL CO.
South Bend, Ind.

October 5, 1942

Mr. Walter J. Herr
Mid-Continent Pet. Corp.
310 South Michigan
Chicago, Illinois

Dear Mr. Herr:

We fully realize the necessity during these times for an all-out effort to maintain sales volume, and we are making excellent use of the plans and advertising which you have made available to us.

It is certain that only the fittest will survive and with your continued cooperation we will do our share in keeping home fires burning.

Yours very truly,

GAFILL OIL CO.
By B Gafill

Products of Mid-Continent Petroleum Corporation

D-X AND D-X ETHYL

DIAMOND 760 MOTOR OIL — DIAMOND GREASES

ALVARADO OIL CO.
Alvarado, Minnesota

September 23, 1942

Mid-Continent Petroleum Corp.
310 South Michigan Avenue
Chicago, Illinois

Gentlemen:

Three years ago we negotiated our Diamond D-X franchise and it was a wise turn. The first year sales increased 8%, second year 14%, and with many distributors experiencing decreasing sales, we expect to end this year with another nice increase. Mid-Continent cooperation has brought us many new customers.

We are particularly appreciative of the sales promotional help given by your representative. He is not only willing to help us secure new business, but is fully qualified to council us regarding credits and collections, business trends and pertinent facts to increase our net profit.

Yours very truly,

ALVARADO OIL COMPANY
Dan Dahlstrom and Sons
By Dan Dahlstrom

Throughout the Central States, Diamond D-X distributors report that survival through wartime conditions is possible and that profits can be made. Up-to-date merchandising and promotions are provided by Mid-Continent to assist the distributor and his dealers to get more than their share of business under rationing or other unforeseen conditions. The complete line of quality Diamond D-X petroleum products, including the famous D-X Lubricating Motor Fuel and Diamond 760 Motor Oil... plus comprehensive selling plans...is the winning combination. At your request and without obligation, a Diamond D-X representative will explain how these plans work. Write, wire or phone the nearest Mid-Continent office.

MID-CONTINENT PETROLEUM CORPORATION

CHICAGO OMAHA TULSA WATERLOO TERRE HAUTE

Operation of the pumps is by remote control from the platform and the operator does not have to leave during the loading operation

with the exception of Port St. Joe and the river plant on the Tennessee River, is equipped to handle loading of tank cars and transport trucks.

The terminals can accommodate from 4 to 20 tank cars depending on the size of the plant. Gasoline is pumped into the cars at rate of 300-500 gal. per minute by remotely centrifugal pumps operated from the platform of the rack.

From 2 to 4 trucks can load at one time at the standard design terminals, and the centrifugal pumps are also remotely controlled from the platform so that the operator who loads the truck can remain on the rack at all times during the operation.

The total capacity at all the 9 terminals is 380,000 bbls. of which 80% is represented by special types of vapor conserving storage tanks.

At the merry-go-round terminal, 6 tank trucks can be loaded and dispatched in 15 to 25 minutes. On every other side, loaders are installed for all commodities handled at the terminal, while on alternate sides only regular gasoline can be handled.

Measuring and billing of transport truck loadings is accomplished on a basis of meter readings at each of the terminals. Automatic ticket printers are provided with each meter and the printer stamps the gallonage figure on the ticket before and after the loading operation. By subtraction the exact amount loaded is determined.

The meters are regularly checked and adjusted with a reliable 1000-gal. prover tank approved by Georgia's department of weights and measures. This assures accuracy, although the meters are reported to have proven correct to within a plus or minus one-tenth of 1%.

Air eliminators have been installed near the racks in each of the pipelines before they reach the meters. These extract all the air which might have collected in the line and allow the positive displacement meter to record accurately. The eliminators also serve to remove all foreign material such as dirt and particles of rust and water.

It Happened Last Year!

A Day-by-Day Account of 1942's Oil Highlights, Condensed from Most of the Important News in Platt's Oilgram, NPN's Companion Daily

January 2: Leon Henderson said U. S. "might" commandeer private cars. All types of synthetic rubber were placed under complete allocation. East coast gasoline stocks on Dec. 27 were 2,499,000 bbls. ahead of same date last year.

Monday, January 5: William F. Huff was named director of a new OPC Division of Materials. Increased movements of tank cars to East Coast indicated diversion of coastwise tankers to the Pacific.

January 6: Petroleum Industry Council for National Defense began discussion of measures to curb loss of oil technologists to the draft. Manufacturers urged delay in issuance of oil marketing equipment conservation order (M-68-c).

January 7: Petroleum Coordinator Ickes announced that the Southwestern pipeline would go into full operation "within a few days". Restrictions on drums for export were eased.

January 8: Ickes told his press conference: "I don't see any necessity for gasoline rationing, as this will take care of itself because of rubber shortage." Less whiskey and more 190 proof ethyl alcohol beginning Jan. 15, ordered by Donald M. Nelson.

January 9: OPA modified used drum price ceilings; halted a heavy fuel oil price hike at East Coast points.

Monday January 12: OPA hit at crude premiums in East Texas.

January 13: Complete texts of P-98, the new general priorities order for the entire oil industry, and M-68-c, the limitation order on oil marketing equipment, were teletyped from Washington and issued to Oilgram subscribers. A $400,000,000 program to increase synthetic rubber production to 400,000 tons a year was started.

January 14: OPC issued an amendment making possible completion of oil and gas wells "spudded" on or before Dec. 23.

January 15: OPA stated that "victory" tires were to be rationed.

January 16: Oil flow to East Coast was tightening with shortage of some importance probable, an Oilgram story revealed. A group was named to handle rationing in Pacific Northwest.

Monday Jan. 19: OPA set up formula for determining maximum prices under its Nov. 7 "freeze" letter. East coast "gas" stocks were sluffing off.

January 20: Bunker oil price ceiling was set.

January 21: OPA set up a formula in attempt to clarify its price-freezing letter of Nov. 7, 1941.

January 22: OPA approved an East Coast "gas" price hike.

January 23: Rails started hauls from Southeastern pipeline. U. S. tightened control of rubber. Rep. Patman would limit tire sales to "independents" under a bill in Congress.

Monday January 26: OPA informed petroleum industry that Nov. 7 (1941) prices on petroleum products and crude prices prevailing Oct. 1, 1941, are regarded as "frozen" unless OPA approved advances.

January 27: Eastman said ODT should handle truck rationing.

January 28: WPB amendments permitted completions of natural gas wells in the Appalachian area.

January 29: Ickes told his press conference oil situation on east coast "is tighter than it was".

January 30: Tank car situation will get worse, 50 Chicago oil men told by tank car leasing companies.

Monday, February 2: Rubber scrap price ceilings set. Used steel drum price ceilings revised by OPA.

February 3: OPA provided no crude rubber for civilian tires or recapping. O'Mahoney bill to promote wildcattting on public lands introduced.

February 4: Story and complete text of OPA's formalization of all price requests and letters mailed to Oilgram subscribers.

February 5: "Oil Is Ammunition — Use It Wisely" and "Care For Your Car For Your Country" oil conservation advertising campaign launched at February meeting of Petroleum Industry Council for National Defense.

February 6: Plan for pooling East Coast oil supplies revealed to Oilgram by a War Production Board official.

Monday February 9: Ickes provides for pooling East's oil supplies.

February 10: Texas crude output declined, while storage climbed. U. S. crude production hit all-time high.

February 11: Membership of East Coast "pooling committee" named. OPA announced renewed tire rationing beginning Feb. 19.

February 12: Wright Gary, OPC refining director told refiners they need not fear "over capacity of 100-octane plants after the war."

February 13: Truck sales "frozen" until Feb. 28.

Monday February 16: Two tankers were sunk at Aruba. Plantation pipeline completed its initial test. Natural gas use was curtailed.

February 17: Ickes again urged East Texas-New York pipeline.

February 18: Detailed well spacing provisions issued by WPB upon recommendations of OPC. A tanker pooling plan was recommended by Ickes.

February 19: OPA released another oil price amendment. Nation-wide "gas" rationing was seen by Ickes. He and Cole committee discussed protection for oil companies from antitrust action.

February 20: Ickes approved a plan for systematizing fuel oil deliveries. Tank car shipments to East Coast averaged 256,725 b/d of crude products for week ended Feb. 14, breaking all records. Plantation pipeline started delivering gasoline to Greensboro.

Monday February 23: Steel deliveries to oil industry were restricted.

February 24: Mid-Continent refiners answered

Flexible . . . at 70° below

THERE are very few rubber-like materials that retain their flexibility at 70° below zero. One of them is Thiokol* synthetic rubber. In fact, "Thiokol" stocks have been compounded that remain flexible at temperatures as low as minus 85° F. And our research laboratory expects to develop stocks that will be flexible at temperatures as low as minus 100° F.

The Thiokol Corporation laboratories have amassed much interesting test data on synthetic rubber at very low temperatures. This, added to a wealth of information on Thiokol's oil-proofness, flexibility, durability and resistance to gases under pressure, puts Thiokol Corporation in a unique position to help you with your war-product problems.

For complete technical data, write:
Thiokol Corporation, Trenton, New Jersey

Thiokol*
SYNTHETIC RUBBER
"America's First"

*Thiokol Corporation trade-mark, Reg. U. S. Pat. Off.

New Jersey Standard's wire appeal telling of desperate need for kerosine, range oil, No. 2 heating oil and other grades of fuel oil in East.

February 25: OPA internal friction blamed for Mid-western price muddle by Mid-Continent and Mid-Western oil men.

February 26: A plan for government to buy and distribute new tires was announced by OPA. Rationing coming in East, well informed sources in New York told Oilgram.

February 27: East Coast stocks of heating oils and heavy fuels were pooled.

February 28: Critical East Coast fuel oil situation was reviewed in a special edition of Oilgram. Prediction was made by Oilgram's Washington bureau of a fuel oil conversion order.

Monday March 2: Leon Henderson told P.I.W.C. of proposed "reorganization" of OPA.

March 4: WPB halted truck manufacture for civilian use. Dismissal of Madison damage suits asked. Morgenthau explained his depletion plan.

March 5: Ickes said gasoline rationing is "imminent"; Henderson said it "may" be rationed to save tires.

March 6: WPB turned down Ickes' suggestion for a 1580 mile pipeline from Texas to New York.

March 7: P.I.W.C. "positively and unequivocally opposed the rationing of gasoline and other petroleum products in any portion of the U. S. where there is a sufficient supply of such material available to the consuming public."

Monday March 9: Transports and tank trucks "refrozen" by WPB. East Coast's supply situation "worse".

March 10: Four more "Madison" treble damage suits were dismissed by Judge Stone in Madison federal court.

March 11: OPA modified restrictions on use of base stocks in lower-octane aviation gasoline.

March 12: Oilgram forecast an order curtailing additives for lube oils.

March 13: WPB was drafting an order for curtailment of gasoline and curfew on sales for the East coast.

March 14: Drastic restrictions on the use of fuel oil and oil burners were imposed by WPB. Gasoline deliveries to stations in East and Northwest were ordered cut 20% effective April 1.

Monday March 16: Method of determining March "gas" quotas under the new L-70 explained by OPC. More camelback was allowed the big recapping plants.

March 17: Formal request for higher gasoline prices to offset increased rail rates was made to OPA.

March 18: Suppliers were authorized by OPC to share equitably increased costs of hauling to East and increased revenues accruing from any higher prices approved by OPA.

March 19: Ickes says "gas" rationing to start in East and Northwest when Henderson is ready. OPC began inclusion of natural gasoline and condensate in certifying production rates.

March 20: Treasury's proposed changes in oil depletion were under fire in the Senate.

March 21: OPA denied request for crude advance in Texas Panhandle.

Sunday March 22: Copy of amendment covering oil marketing equipment mailed Oilgram subscribers for Monday morning consumption.

Monday, March 23: Conservation order M-68-C, as amended became effective. OPA started series of meetings to get industry's arguments for price hike to cover recently-increased rail rates.

March 24: Committees from Districts 1, 2 and 3 discussed means of increasing oil shipments to the East at a meeting in Washington.

March 25: OPA granted a 25c hike on Pennsylvania crude, permitted higher prices at East Coast points.

March 26: U. S. refining processes were made available to Russia with approval by Justice Department of OPC Recommendation 42.

March 27: OPC issued a directive calling for shipments of specific quantities of products from Districts 2 and 3 to District 1 as emergency measure; refinery yield changes also involved.

Monday March 28: A pooling plan for District 2 was approved by OPC. W. S. Farish, president of New Jersey Standard, denied his company hindered and delayed production of synthetic rubber in U. S., as charged by Justice Department's Arnold.

March 30: Oilgram reported WPB was expected to issue a ban on making of metal containers for oil; a District 5 transportation cost-sharing plan was okayed by OPC.

March 31: W. S. Farish denied all of Arnold's charges one by one. OPC orders District 2 pooling plan into effect.

April 1: Farish told of Jersey Standard's failure to interest U. S. in synthetic rubber.

April 2: Fifty per cent gasoline rationing threatened by OPA.

April 3: A.A.A. conferred with OPA on gasoline rationing.

Monday April 6: OPA considered different ways of distributing gasoline rationing books —"if rationing is invoked." OPA was just "thinking" about nationwide gasoline rationing, spokesmen emphasized.

April 7: Texaco shut down its Houston refinery because of transportation shortage. OPC cut fuel oil deliveries in East, Northwest. OPA allowed cut-price stations a larger margin.

April 8: Oilgram reported tip-off on coming 33.33% cut in gasoline deliveries to eastern and northwestern stations.

April 9: Curtailment to 66.66% for East and Northwest gasoline deliveries was ordered, effective April 16. Ickes said: "If this program works satisfactorily, we may go to Henderson and tell him that we see no occasion for card rationing."

April 10: P.I.W.C. recommended 12-hour-day gasoline sales nationwide.

Monday April 13: OPC began studies on a broad program of digging up and relaying pipelines to ease East Coast shortage.

April 14: Ickes urges "strong, active" state oil conservation laws at first meeting of National Conference of Petroleum Regulatory Authorities.

April 15: WPB halted domestic oil burner manufacture. National Conference of Petroleum Regulatory Authorities agreed states should follow OPC production recommendations.

April 16: Dr. John W. Frey, OPC marketing director, predicted "card" rationing of gasoline within 3 or 4 weeks. Treasury renewed its fight to kill off oil depletion allowance. National Petroleum Assn. met in Cleveland.

April 17: Higher surcharges on off-shore tanker hauls were granted.

Monday April 20: Oilgram disclosed gasoline rationing plans as worked out for 2 or 3 test states on the Atlantic seaboard. OPA considered a temporary rationing plan.

April 21: Public Roads Administration reported a sharp drop in highway travel. Ban on use of benzene in motor fuel was issued.

April 22: Henderson announced temporary card "gas" rationing in District 1 to start May 15.

April 23: Gulf coast refinery control plan announced. OPA banned conversion of "split" accounts to 100%.

April 24: Davies says materials delay may hold back synthetic rubber. Hallanan, president of Plymouth Oil Co., Pittsburgh, termed the Eastern gasoline rationing program "half-baked, hit and miss, and a morale breaker" for Eastern motorists.

Monday April 27: OPC prohibited the use of asphalt on roads. Congressional probe of "gas" rationing was asked.

April 28: WPB ruled that new heavy trucks could be equipped with tires and tubes. A pipeline, with terminals, and a barge canal was planned across Florida.

April 29: Gasoline curtailment might be extended from East Coast, Deputy Petroleum Coordinator Davies advised Georgia's Sen. George. OPA approved another East Coast price advance.

April 30: Office of Petroleum Coordinator for National Defense changed its title to Office of Petroleum Coordinator for War. Texas kicked over traces on OPC's recommended production rates.

May 1: OPC was making plans to increase East's rail hauls to 800,000 b/d.

May 2: Temporary Maximum Price Regulation on retail gasoline in East and Pacific Northwest to be continued to May 18, OPA announced.

Monday May 4: OPA issued gasoline rationing regulations curtailing East Coast deliveries. Eastman was given broader powers over transportation.

May 5: ODT set up tank car control machinery.

May 6: Mid-continent refiners were told to hold up gasoline shipments destined for East Coast.

May 7: OPC formed a natural gas, natural gasoline division. P.I.W.C. was urging higher Eastern oil prices.

May 8: Henderson discussed subsidy and "gas rationing" with Cole oil investigating subcommittee.

May 9: Move was on for nationwide gasoline rationing, an exclusive Washington story in Oilgram revealed.

Monday May 11: WPB gave gasoline rationing authority to OPA.

May 12: Jersey Standard offered an "alky-rubber" process free to U. S.

May 13: WPB cut fuel oil deliveries by 50% for certain purposes in curtailment area.

May 14: Ickes office discussed an oil price subsidy with OPA.

May 15: Rail hauls to East were climbing, while the Northwest was off.

Monday May 18: Suit was filed in Los Angeles to break a station lease on account of the war.

May 19: President Roosevelt said rationing was not needed where oil is ample.

May 20: ODT studied use of wooden barges for gasoline.

May 21: OPA was working on a nationwide gasoline rationing program with no exempted areas, Oilgram revealed. Well spacing in Illinois was liberalized.

May 22: Donald Nelson and his rubber chief said car and tire requisitioning might be nec-

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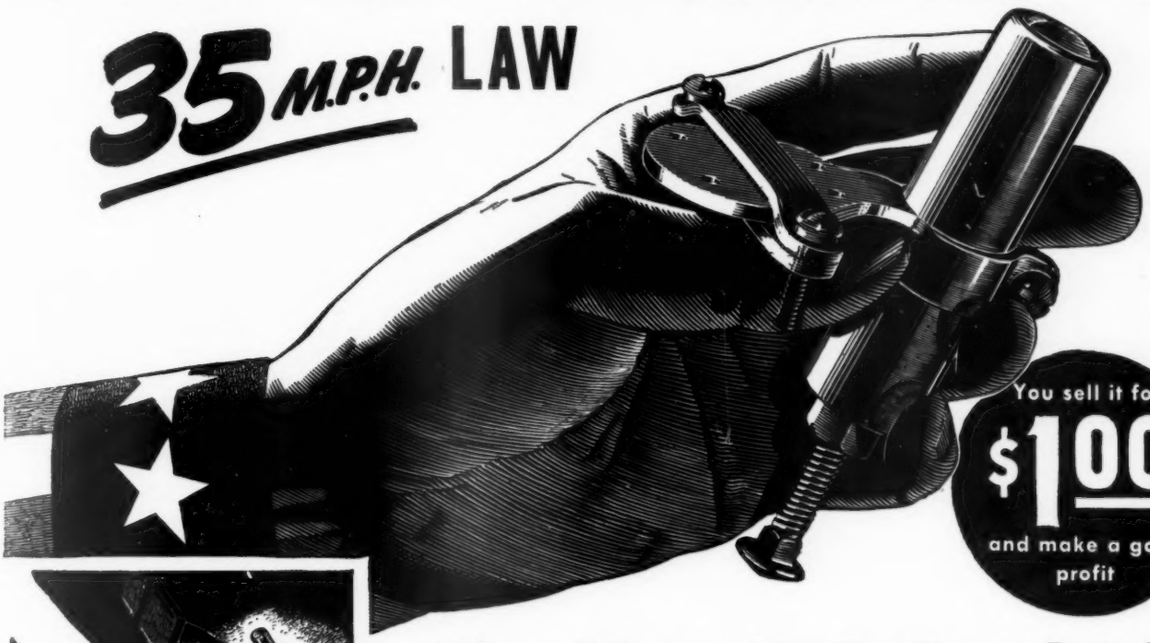

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NOW'S the time to get in on the tremendous demand for this timely device, created by the new 35-mile-per-hour speed law and national gasoline rationing.

The public is speedometer conscious, tire conscious and gasoline conscious. Patriotic motorists are snapping up these B. F. Goodrich *Speed Wardens* that help them obey the law without dangerous speedometer watching . . . and also help them save precious tires and get more miles from their gas.

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Your store becomes headquarters for speed control and tire and gasoline savings.

Production is increasing every day. But the demand is great. Don't wait. Order your supply today. Give your customers . . . and yourself . . . the benefits of this *Speed Warden.*

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B. F. Goodrich is backing the *Speed Warden* with a big national advertising campaign, running in leading magazines and newspapers, and with complete merchandising tools . . . window trims, posters and mail pieces. These sales helps will help you to extra profits.

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*Patent applied for

essary. OPA reduced June tire quotas by 16.5%.

Monday May 25: Roosevelt ordered building of 1000 wooden oil barges.

May 26: Little hope was seen for relief of East Coast by Ickes. The 100-octane program was exceeding expectations, Deputy Petroleum Coordinator Davies told Cole oil subcommittee.

May 27: Discounts were "frozen" as of Oct. 1-15 by OPA.

May 28: Many stations were dry in the East for the coming holiday.

May 29: Details were published of a Senate group's plan for 30,000,000 retreads a year. Wright Gary, OPC refining director told of plans to utilize small plants.

Monday June 1: Northwest gasoline cut order was rescinded.

June 2: WPB was considering nationwide gasoline rationing.

June 3: OPA had tentatively prepared its plans for nationwide gasoline rationing beginning July 1, "to save rubber".

June 4: Details were given on the 7 types of ration books as prepared for OPA for the East Coast. A.A.A. asked for 90-day halt in nationwide rationing. Gov. Payne Ratner of Kansas protested gasoline rationing.

June 5: P.I.W.C. proposed a rubber replacement plan. Congress passed bill (S.2250) suspending anti-trust action on acts done to further war effort.

Monday June 8: Roosevelt promised to study the problem before approving nationwide gasoline rationing.

June 9: OPA told of undercover methods used in catching ration violators in East. FDR announced he was confused on the rubber facts.

June 10: OPC disclosed plans for a "quickie" butadiene program. WPB approved a 550-mile, 24-in. pipeline from Longview, Tex., to Norris City, Ill.

June 11: Maloney committee proposed a gasoline rationing probe. Oil industry's wartime organization was poised for an immediate launching of a nationwide scrap rubber collection campaign.

June 12: FDR announced oil's scrap rubber drive. Announcement of permanent gasoline rationing on July 15 in the East was made. Oilgram reported the government was eyeing motorists' fifth tires.

Monday June 15: Scrap rubber drive got off to a good start.

June 16: Ickes urged Easterners to convert to coal.

June 17: The cross Florida pipeline was approved. Private tire stocks in warehouses were frozen by OPA. Arthur B. Newhall, rubber coordinator, said that with care tires would last 4 years.

June 18: OPC Refining Director Gary conferred with refiners on the "quickie" butadiene plan.

June 19: Oilgram predicted a continuance, "for the duration", of the big anti-trust suit against the A.P.I. and 22 majors and their affiliates would be sought.

June 20: Henderson's statement regarding confiscation of private automobiles was "sabotaging" the scrap rubber drive, an Indianapolis oil man wired President Roosevelt. Henderson denied it.

Monday June 22: A truck maintenance campaign (U. S. Truck Conservation Corps) was launched by ODT.

June 23: Censors ban reports on scrap rubber drive. OPA sets ceilings for auto service.

June 24: Over 100,000 tons rubber collected in first 5 days, Roosevelt announced.

June 25: Ickes urged passage of bill to create a War Petroleum Corp. (designed to centralize control over petroleum industry). Antifreeze price ceilings were set by OPA.

June 26: Atlantic coast mayors proposed a 4 point program on gasoline rationing.

June 27: Price advances were granted by OPA on gasoline and light fuels in East. Butadiene put under allocation control by WPB.

Monday June 29: Scrap rubber drive extended 10 days.

June 30: OPC was busy with plans for an oil equipment inventory control system; scope was under study.

July 1: OPA Chief Fuel Rationer Dean attempted to block Oilgram's news report about his conference with 200 oil company representatives on gasoline rationing plans for East Coast. Complete text of the OPA plan was published.

July 2: Membership in the East Coast cost-profit sharing "pool" was offered to independents.

July 3: Exchanges of technical information on toluene manufacture were approved by Justice Department. Oilgram story indicated fuel oil restrictions in Northwest (under L-70) would be eased up.

Monday July 6: Asphalt restrictions were extended by OPC to Districts 2 and 3.

July 7: The scrap rubber drive reached a total of 334,293 tons.

July 8: ODT started meetings to explain Truck Conservation Corps campaign. Ickes praised oil industry scrap rubber drive.

July 9: Ickes confirmed Dr. John W. Frey's promotion to special assistant, which had previously been predicted by Oilgram.

July 10: Fuel oil restrictions were lifted in the Northwest.

Monday July 13: Sen. Gillette's "alky-rubber" subcommittee heard Houdry witnesses attack butadiene process chosen by Rubber Reserve Co.

July 14: Nelson said WPB would go ahead with present plans on synthetic rubber.

July 15: "Civilian rubber picture is not so gloomy", W. S. Farish told the House mines and mining subcommittee.

July 16: P.I.W.C. urged rubber "regardless of source".

July 17: OPA said most of the recent price advances allowed in East Coast area would be withdrawn.

July 20: WPB killed East Coast gasoline curtailment (L-70) in coupon rationing area in preparation of a permanent plan.

July 21: Tire industry unveiled a plan for solving the tire shortage by providing reclaimed tires. Sen. Gillette attacked "stumbling" in the synthetic rubber program.

July 22: OPA allows "pay you later" plan on coupons.

July 23: Higher tire, tube quotas were set by OPA for August. ODT announced plan for encouraging the use of trucks.

July 24: Mansfield, Ohio, station closing ordnance was found unconstitutional by court. FDR praised oil industry for scrap rubber drive.

Monday July 27: Jesse Jones announced RFC compensation plan on eastern shipments, effective Aug. 1.

July 28: Procedure for relief from ceilings given in an amendment by OPA. Bootleg market described by eastern oil marketer.

July 29: Crossland, of Rubber Reserve, was again quizzed by a House committee. Membership of 2 oil price advisory committees to OPA was announced.

July 30: OPA gives procedure for obtaining price relief.

July 31: Synthetic rubber program's materials needs were told by F. H. Carman, chief of WPB's synthetic rubber program.

Monday August 3: Wright W. Gary resigned as refinery director of OPC. Ickes announced that pipeline gangs would begin laying pipe this week for the Texas-Illinois "big inch".

August 4: Houdry offered 600,000 tons of "quick butadiene". P-98 expired, leaving oil industry without a blanket priority rating.

August 5: A scientific study of synthetic rubber processes was urged by head of National Academy of Sciences.

August 6: Oilgram disclosed OPA was ready with a coupon rationing plan for light fuel oil. FDR vetoed the Gillette "alky-rubber" bill, named the Baruch committee to probe rubber situation.

August 7: OPA spokesman said OPA will "insist" on gasoline rationing nationwide.

August 8: Oilgram gave readers a background story on drastic new changes coming for the oil industry; disclosed exclusively that Ickes had said to FDR: "Give me full wartime authority over oil, or I resign".

Monday August 10: Davies warned of gasoline rationing in Mid-West. Tire regrooving was prohibited by WPB.

August 11: Rationing was extended to 7 western New York counties. Sun Oil urged use of half of cylinders to save gasoline.

August 12: Oilgram reported in detail the proceedings of the closed session of OPA with an invited eastern group of oil marketers.

August 13: Ickes discussed Mid-West curtailment, but was silent on rationing.

August 14: Atlantic seaboard independent marketers urged Roosevelt to give Ickes powers needed to fulfill his responsibility. OPC provided for exchange of technical data.

Monday August 17: ODT moved to take control over all waterway oil barges.

August 18: Rep. Rogers of Massachusetts urged Roosevelt to put oil under a single head. OPA imported an advisor from England on its "concentration" plan.

August 19: Jersey's President Farish tangled with Senate patents committee.

August 20: Plan for linking Great Lakes tankers to pipelines for eastern oil shipments was revealed.

August 21: Gasoline tank car shipments in 20 Mid-Western states were banned by OPC.

Monday August 24: Wisconsin oil men were turned down by OPA on request for price increase.

August 25: Centralized oil control was discussed at meeting of WPB, OPA and ODT with OPC. Wooden oil barge program was threatened by WPB decision to convert dry cargo carriers to oil service.

August 26: Strike in Chicago halted production at 3 refineries.

August 27: Fuel oil rationing committee of WPB met in Washington.

August 28: Work was stopped on emergency 24-in. pipeline by "goons".

August 29: Work was resumed on emergency pipeline as union demands were under negotiation. "Critical occupations" in oil were listed.

Monday August 31: Temporary relaxation of well spacing order was announced for Illinois, Indiana and Kentucky producers.

September 1: RFC announced details of compensation plan to offset substitute oil transportation costs.

September 2: Effect of curtailed fuel on passenger cars and trucks was told to P.I.W.C. by a special subcommittee.

September 3: Ickes expressed favor for one-man control of oil at his press conference.

P.I.W.C. shied away from "Huff plan" for inventory control of oil industry equipment.

September 4: Davies said: "Ration Mid-West oil only if necessary". OPC's Collier warned Mid-West to convert to coal.

September 8: ODT widened tank car ban in Mid-West to 200 miles.

September 9: WPB removed drum color coating restrictions. Proposed order to halt doctor sweetening was abandoned.

September 10: Baruch committee recommended nationwide gasoline rationing. Ickes told Congress he favors one-man control of oil.

September 11: ODT emphasized that its Certificate of War Necessity program did not constitute gasoline rationing. Texas governor said his state would fight gasoline rationing.

Monday September 14: Use of steel drums restricted by WPB order. Texas' Gov. Stevenson formally protested gasoline rationing.

September 15: Davies said drastic steps must be taken to supply East. P-98, oil industry's priority order which had expired, was being revised with ratings upgraded.

September 16: Fuel oil deliveries were limited in 30 states. New P-98B, replacing extinct P-98, was issued.

September 17: Davies tells National Petroleum Assn. meeting in Pittsburgh that some brand names will disappear. Ickes, in Washington, disclosed outline of plan for pooling all East Coast's oil supplies.

September 18: Oil's profit rate is off 15%, Dr. John D. Gill tells N.P.A.; Harry A. Logan elected president.

Monday September 21: Sen. O'Mahoney of Wyoming scheduled hearings on hiking oil production.

September 22: Gasoline rationing announcement was awaiting settlement of ODT and OPA row over who should handle it.

September 23: Zones for fuel oil rationing were set up by OPA.

September 24: WPB ordered ODT to set up tank car priorities. The East Coast cost sharing "pool" was $31,333,723.05 in the red as of July 31, a statement revealed.

September 25: Rail shipments to East reached 856,710 b/d in week ended Sept. 19 (highest in 1942).

Monday September 28: OPA mapped a price relief plan for gasoline resellers, permitting a choice between two base dates.

September 29: Jeffers said the eastern coupon gasoline rationing plan would be used nationwide to save time.

September 30: OPA wrote suppliers explaining its retail margin policy. The "big inch" pipeline was reported 29% complete.

October 1: Wet and dry gas price ceilings were brought under Schedule 88. Fuel oil rationing started in 30 eastern and mid-western states.

October 2: Eastman requested pooling of local oil deliveries.

Monday October 5: OPC extended asphalt restrictions to nationwide basis.

October 6: A P.I.W.C. resolution urged price increases throughout the oil industry.

October 7: Roosevelt said he believed oil control should be centralized.

October 9: OPC revoked tanker sharing recommendations. OPA ordered refiners, terminal operators to submit lists of invoices on sales. Henderson said he saw no need for crude price hike.

Monday October 12: WPB restricted uses of petroleum coke. Controls were tightened over tire retread equipment.

October 13: Michigan jobbers asked 90-day delay in gasoline rationing.

October 14: Jeffers named a technical rubber committee.

October 15: Jeffers heard Texas' protest against gasoline rationing. Senate passed a bill giving Army and Navy power to force reductions in patent royalties.

October 16: Truckers protested 35 mile speed limit. Rationing boards were called upon to appoint tire inspectors.

October 19: Jeffers said that a delay in rationing was probable. Announcement was made that octane of ethyl was to be raised from 78 to 80.

October 20: Fuel oil rationing program was described by OPA.

October 21: The "big inch" pipeline was half-way completed. McNutt hinted that rationing might be used to control manpower.

October 22: OPA set specific prices for Michigan fuel oils.

October 23: Hoosiers organized an anti-gasoline rationing committee. Michigan governor and Sen. Brown issued statements in support of delay in gasoline rationing.

Monday October 26: OPA issued a list of "C" eligibles under national gasoline rationing.

October 27: Applications for basic gasoline rations were being distributed.

October 28: Thirty-five Texas legislators asked for larger gasoline rations. OPA lifted ceilings on well drilling and servicing. Ickes urged a second pipeline to the East Coast.

October 29: A new ceiling on Wyoming and Oklahoma heavy fuel oil was set by OPA.

October 30: Ruling was made that lube in jobbers' hands was not subject to new 1.5c tax boost.

Monday November 2: Earl Godwin, radio news commentator, declared gasoline rationing would hurt Detroit's war output. Controlled Materials Plan was announced.

November 3: A new WPB order further restricted drums and parts. OPA was acting to halt individual price adjustments.

November 4: OPA said truck fleet owner's employes may inspect tires. Maximum production of petroleum coke ordered of 13 refiners.

November 5: A.P.I. issued warning to change oil every 1000 miles or less. Truck operators were facing halt of operation through delay in war certificate program. Jeffers' spokesman attempted to bottle up story on Hoosier fight against rationing.

November 6: McNutt announced a new plan for systematizing withdrawal of manpower.

Monday November 9: P.I.W.C. said the East Coast supply problem was growing worse. OPA issued regulations for nationwide gasoline rationing.

November 10: P.I.W.C. ordered a test of tubeless tires. Nationwide rationing of gasoline was delayed until Dec. 2. OPA was formally given "mileage" rationing authority.

November 11: W. R. Boyd, Jr. and other A.P.I. officers were re-elected for 1943. WPB announced that the oil industry was eligible for AA-1 priorities.

November 12: The gravity of materials shortage in production was emphasized at A.P.I.'s dealers to pass on the lube tax increase. Ickes 23rd annual convention. OPA permitted said independents must live.

November 13: Extension of the "big inch" pipeline to the East was approved. Baruch said "No" to congressman's plea for postponement of nationwide gasoline rationing.

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Final arrangements may result in your coming into our company—or a proposition might be worked out on a royalty or some other desirable basis.

If you feel you have something on which we could work together, please communicate with us, giving us full particulars. We can then arrange for a meeting if the ideas are adaptable to our plant and facilities, or adaptable to facilities which we might wish to add to carry out this idea.

★ ★ ★ ★ ★

STANDARD STEEL WORKS

NORTH KANSAS CITY, MO., U. S. A.

Monday November 16: OPA issued indentification rules for gasoline coupons. Rep. Disney, Okla., asked OPA for "realism and intelligence" on oil prices. National Council of Independent Petroleum Assns. urged support of resolution to delay gasoline rationing.

November 17: Limitations on pumps and tanks were changed by WPB by revision of Order M-68-c. Rep. Wickersham, Okla., hit rationing in two resolutions in Congress. "A" coupons in the East were cut from 4 to 3 gal.

November 18: Oklahoma's clamor for gasoline rationing delay increased. Five officials asked postponement of gasoline rationing. Congressional opposition to gasoline rationing was growing. Jeffers investigation of gasoline ration protests collapsed.

November 19: Jeffers told Senate Banking and Currency committee that he, not Henderson, was going to run the rubber program.

November 20: Speaker Sam Rayburn said he would ask Roosevelt to defer gasoline rationing. Congressmen were waiting on Rayburn in their fight against rationing.

Monday November 23: Illinois retailers asked for rationing postponement. Deadline on coupon credits for fuel oil was extended by OPA. Oklahomans wired FDR in protest of gasoline rationing. Rationing protests in Congress were growing in volume.

November 24: Natural gas limitations were extended by WPB. Jeffers admitted tremendous opposition to gasoline rationing.

November 25: OPA set maximum prices for reclaimed tires. OPA saw more cuts in eastern oil consumption.

November 27: House members attacked Henderson as climax neared on nationwide gasoline rationing. Texas governor said gasoline rationing protests should not stop despite Roosevelt's direction that rationing start Dec. 1.

Monday November 30: An order was being prepared banning premium grade motor fuel sales to the general public in the East Coast area. ODT explained temporary transport rations. W. S. Farish, 61, Jersey Standard's president, died at 2:30 a.m. Nov. 29.

December 1: A tubeless tire was demonstrated before the Lea oil investigating committee. Texas rationing board gave government agencies rough treatment. Henderson "apologizes" for calling gasoline rationing opponents "ignorant traitors". The new 3% transportation tax must be absorbed, OPA ruled.

December 2: Ickes gets broad powers in new oil order creating the Petroleum Administration on for War.

December 3: Sen. Truman was displeased at the rationing setup after a Kansas City hearing. Congressional leaders lash out at Henderson.

Monday December 7: ODT-PAW jurisdictions were outlined by Eastman. Work was being planned for full scale operations through the winter on the "big inch" pipeline.

December 8: Indiana Standard lost $2,000,000 tax case. Burner Oil Distributors Assn. request dropping fuel oil coupon system in Chicago. Leon Henderson was reported "on way out".

December 9: PAW cut movement of gasoline by tank car into East. Rules were eased to permit steel in pumping well units. Tire dealer replenishment rules were relaxed by OPA.

December 10: Price Administrator Henderson "resigned". WPB approved manufacture of 300 tank trailers.

December 11. Truman committee criticized the administration of rationing. Chicago distributors urged abandonment of coupon fuel oil rationing.

Monday December 14: Chicago oil men gave addresses of cold homes at meeting with OPA's Chicago director. Davies told leading marketers that credit cards would be out on Jan. 1.

December 15: Chicago rationing director asked permission to hike allotments of fuel oil. Fuel oil dealers were circulating petitions asking change in OPA's coupon system of fuel oil rationing.

December 17: Ickes again urged only "essential" use of gasoline in East.

December 18: No. 59 directive by OPC was amended. The East Coast gasoline supply situation was reported still snarled.

Monday December 21: Crews started to work on the extension of the "big inch" pipeline to the East. OPA asked the oil industry to police the black market. OPC set definite quotas for stock withdrawals by eastern suppliers.

December 22: OPA halted issuance of "B" and "C" cards in the East. Mid-west Period 3 fuel oil ration coupon values were hiked 10% by OPA.

December 23: Rail hauls to the East showed slight rise. ODT urged proper truck and car lubrication.

Monday December 28: P.I.W.C. started an oil industry manpower survey. OPA cleared the way for price increases in gasoline, fuel oil and dry gas by a series of orders issued over the holidays.

December 29: Tank cars were frozen in Eastern service.

December 30: OPC banned use of credit cards for gasoline at more than one station by any customer. Maloney committee took over oil of Truman committee.

December 31: OPA set specific fuel oil maximum price structure for Boston area. Ickes forecast a deeper oil ration cut in 1943. P-98B was extended with several major changes.

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Here's a combination you can't beat —a fine quality oil at a money-saving price—exactly what every motorist wants. Fort Pitt is one of the famous FREEDOM brands of 100% Pure Pennsylvania motor oils, refined in one of Pennsylvania's oldest, most modern refineries. Write for exclusive territory today. Franchises also available for the exclusive sale of Penn Trump, Four-State and Beaver-Penn. Ask for full particulars.

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PACIFIC COAST BULK PLANT AND WAREHOUSE—LOS ANGELES, CALIF.

New Standard is Effective For Pot-Type Oil Burners

NPN News Bureau

CLEVELAND — A commercial standard (emergency) for warm air furnaces equipped with vaporizing pot-type oil burners is now effective for new production beginning Jan. 1, 1943, National Bureau of Standards has announced.

The standard is identified as E-CS104-43. Those concerned with this type of equipment may obtain information by writing the U. S. Department of Commerce, National Bureau of Standards, Washington, D. C., attention I. J. Fairchild, chief, Division of Trade Standards.

Philgas Moves to Bartlesville

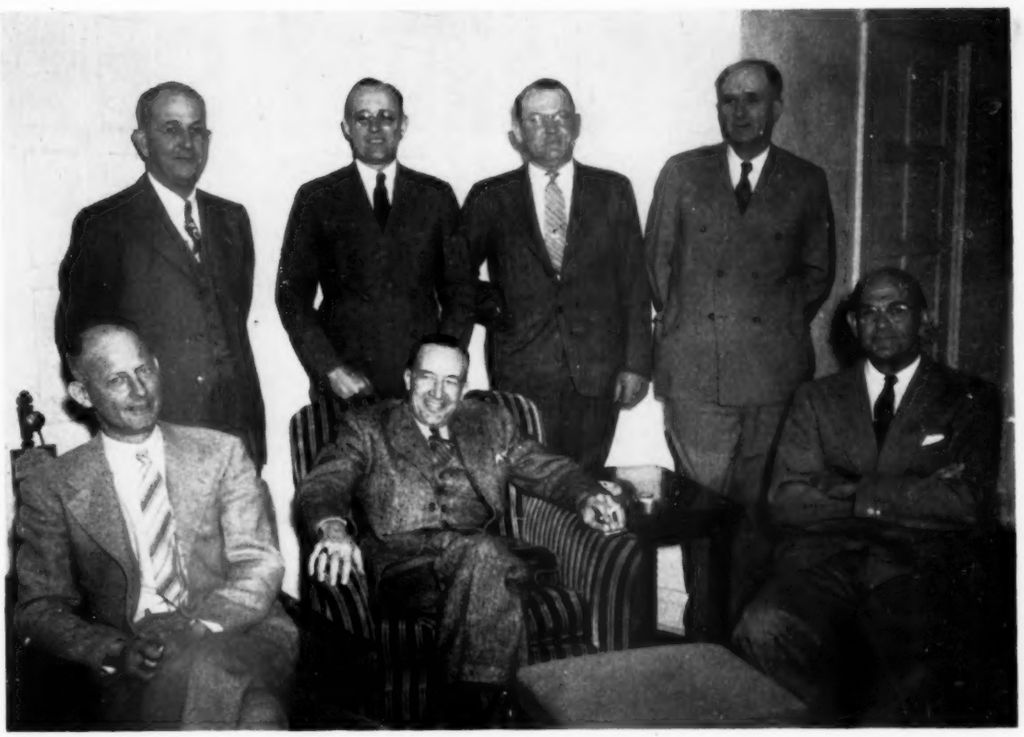
Special to NPN

BARTLESVILLE—Effective December 11, 1942, general offices of Philgas Division of Phillips Petroleum Co. were moved from General Motors Building, Detroit, to Phillips' principal operating offices at Bartlesville, it was announced by Frank Phillips, chairman, and K. S. Adams, president.

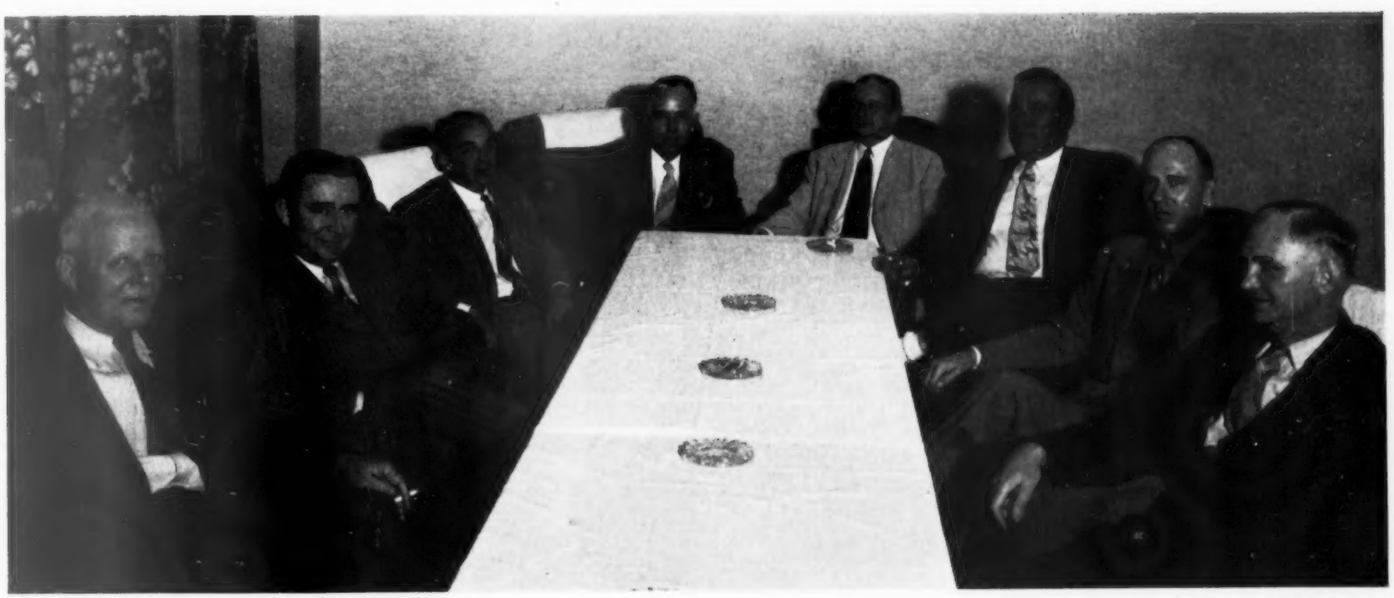
Purpose of the change was to permit closer correlation of policy and operating problems necessary under war conditions, and will involve no essential changes in personnel or operating methods, it was said.

A.P.I.C. Marks 10th Anniversary

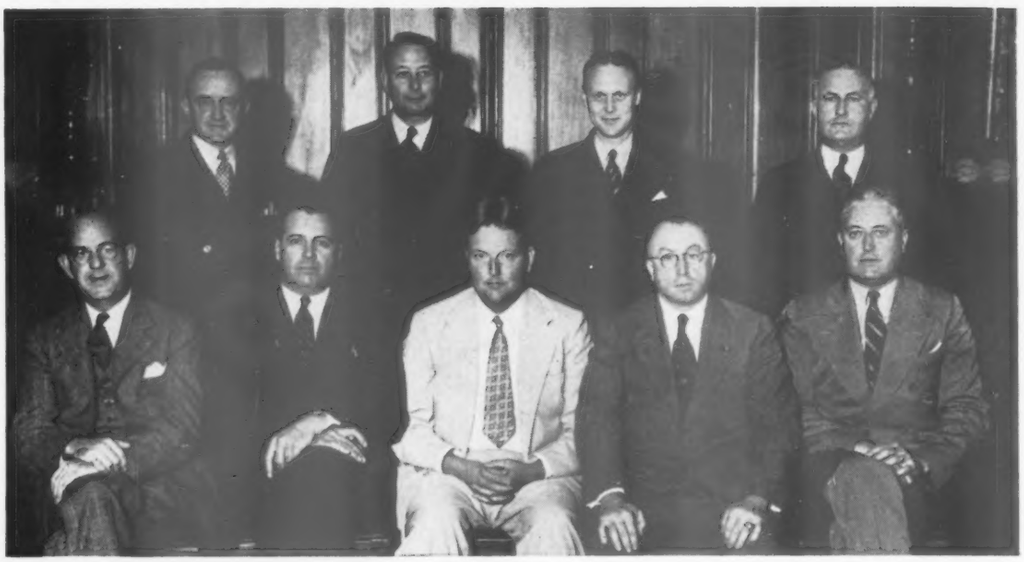
This is the eighth group in NPN's picture series on state committees of the American Petroleum Industries Committee, which is 10 years old. Shown here are the state committees for Louisiana, Kentucky, West Virginia and District of Columbia. For other state groups, see NPN Sept. 9, p. 32, Sept. 30, p. 34, Nov. 18, p. 40, Dec. 2, p. 42, Dec. 9, p. 36, Dec. 23, p. 32 and Dec. 30, p. 35.



Members of the executive committee of the New Mexico Petroleum Industries Committee are: STANDING, LEFT TO RIGHT—G. A. LaBrant, Sinclair, chairman; Dudley Cornell, secretary; A. E. Martin, Texaco; L. E. Ruffin, Texaco, Bernalillo County committee member. SEATED, LEFT TO RIGHT—Paul Simon, New Mexico Oil Co., vice-chairman; C. B. Mitchell, Texas Standard, Bernalillo County committee member; J. P. Anthony, Continental Oil Co. MEMBERS NOT PRESENT—H. L. Hathaway, Texas Standard; F. G. Jamison, Sommers Home Oil Co.; H. D. Starks, Phillips Petroleum Co.



Members of the executive committee of the South Carolina Petroleum Industries Committee are: READING FROM LEFT TO RIGHT—D. S. Lewis, New Jersey Standard; J. C. Harmon, Amoco; J. T. Melton, secretary; L. L. Trego, chairman, Sinclair; Fred Ridley, visitor, Pure; H. H. Hax, visitor, Shell; S. J. Usher, general committee, Gulf; R. W. Gaston, Texaco. MEMBERS NOT PRESENT (Executive Committee) H. H. Bird, Shell; O. Y. Kirkpatrick, former member, Pure Oil Co. of Carolinas, Inc.; S. R. McMaster, Winnsboro Petroleum Co.; J. H. Morehouse, Atlantic; W. B. Roberts, Gulf; T. W. Thornhill, Charleston Oil Co.



Members of the executive committee of the Rhode Island Petroleum Industries Committee are: FRONT ROW, LEFT TO RIGHT—F. R. Curry, Texaco; D. B. Allen, Sun, vice-chairman; B. F. Shea, Colonial Beacon Oil Co., chairman; W. H. S. Callahan, secretary; F. B. McConnell, Gulf. BACK ROW, LEFT TO RIGHT: J. J. Gill, Petroleum Heat & Power Co.; H. W. Jollie, Atlantic; J. McIntyre, Shell; C. A. Sheehan, Socony-Vacuum

Members of the executive committee of the Nebraska Petroleum Industries Committee are: STANDING, LEFT TO RIGHT—V. C. Hascall, Omaha, Nebraska Standard, chairman; H. H. Hahn, secretary; S. T. Hudson, Chadron, Hudson Oil Co.; R. E. Osborn, Omaha, Sinclair; S. A. Wassum, Tekamah, Tekamah Oil Co.; F. F. Colman, Omaha, Texaco; J. K. Durfee, Omaha, Socony-Vacuum. SEATED, LEFT TO RIGHT—J. W. Trenchard, Cambridge, Trenchard Filling Stations; John O. Schmidt, Wahoo, Farmers Union Cooperative Oil Assns., vice-chairman; F. O. Nordstrom, Omaha, Phillips Petroleum Co.; E. Dale Smart, Omaha, Skelly Oil Co.; W. F. Hird, Lincoln, Continental Oil Co.; C. J. Hargleroad, Hastings, Hargleroad Transport Co.

Members of the executive committee of the Minnesota Petroleum Industries Committee are: STANDING, LEFT TO RIGHT—L. S. Loudon, Skelly; B. D. Reinfrank, Bareco Oil Co.; S. M. Burnap, Direct Service Oil Co.; Prentiss H. Savage, Texaco; H. M. Whisman, secretary; G. R. Monkhouse, Shell; G. F. Kielhack, Pure; Thomas B. Murphy, Deep Rock. SEATED, LEFT TO RIGHT—F. O. Nordstrom, Phillips; W. T. Bannister, Indiana Standard; Walter Hoffman, Cities Service, chairman; F. E. Packard, chairman of central division; P. J. Schroeder, Petroleum Service Co.; E. R. Horstmeier, treasurer, central division, APIC. EXECUTIVE COMMITTEE MEMBERS NOT PRESENT—Larry Coleman, Continental; I. B. Kingbay, Globe Oil Refining; Harry H. Moore, Socony-Vacuum; C. M. Swanson, Sinclair

Equipment Personals

E. L. Barringer

E. L. Barringer, a member of the editorial staff of NATIONAL PETROLEUM NEWS from 1926 to 1939, is now on the editorial staff of Chek-Chart Corp. at Chicago. Mr. Barringer left NPN three years ago to join the public relations staff of Ethyl Gasoline Corp. and was assigned to the research laboratories in Detroit as a writer on fuels and engines. His move with Chek-Chart was announced by Ray Shaw, Chek-Chart's president.

° ° °

Harry A. Rapelye, director of the equipment bureau of the War Production Board, is the subject of a biographical sketch just released by the Office of War Information in connection with its series of articles on top executives in WPB. In 1929, Mr. Rapelye became business and sales manager of Continental Can Co. in Kansas City, Mo., and he joined WPB in December, 1941, as chief of the nickel branch. He became assistant deputy director general for operations in September, 1942. Mr. Rapelye is a graduate of Massachusetts Institute of Technology and a native of Hartfort, Conn., where he was born in 1886.

° ° °

Appointment of **B. DeLorenzo** as manager of the heat transfer department is announced by Brown Fintube Co. at Elyria, Ohio. He formerly worked for Foster Wheeler Corp. as a design engineer specializing on heat transfers and flows of fluids.

° ° °

On Jan. 1, Key Co. opened its own district offices in the Southwest. The Houston office is at 1315 Second National Bank Bldg., with **J. H. Richardson** as district manager; the Tulsa office is at 533 Mayo Bldg., with **M. J. Masel** as district manager.

° ° °

St. Marys Manufacturing Co., St. Marys, Ohio, subsidiary of Goodyear Tire & Rubber Co., has been awarded the Army-Navy "E". Presentation is scheduled for Jan. 6.

° ° °

Dunkirk, N. Y., plant of American Locomotive Co. has been awarded the Maritime "M". The award was made on Dec. 18.

° ° °

R. A. Maxwell, with B. F. Goodrich Co. since 1933, has gone into government service as a member of the requirements and capacities section, rubber branch of the War Production Board, company announces. Mr. Maxwell was a member of the war products department of the B. F. Goodrich national sales and service division at the time of his new appointment.

Edward F. Coogan, sales manager since 1936 of Autocar Co. of Ardmore, Pa., has been appointed vice-president. He will continue his former sales supervision of commercial business through the Autocar Co.'s coast-to-coast system of direct factory branches and dealers.

° ° °

Monsanto Chemical Co. announces that 3 more of its plants have received the Army-Navy "E" award bringing to 15 the number of Monsanto plants which have been given the award. The latest 3 plants to receive the award are the company's St. Louis plant at St. Louis, its Chemical Warfare Service, St. Louis plant No. 1 operated for the government at Monsanto, Ill., and its Monsanto, Ill., plant. **William G. Krummrich,** manager in charge of both plants at Monsanto, Ill., will preside at a dual presentation early in January and **Edward J. DePree,** manager of the St. Louis plant, will preside at the St. Louis ceremony.

° ° °

F. J. Rees, advertising and sales promotion manager of B. F. Goodrich Co., has been named sales manager of special accounts of the division, **H. E. Keller,** general manager, announces. Mr. Rees succeeds **M. G. Huntington,** now in Washington, D. C., as manager of the company's national sales and service division offices there. He joined the company 15 years ago.

° ° °

Lewis H. Brown, president of Johns-Manville, spoke recently at ceremonies in which the Army-Navy "E" was awarded to the employes of the Kansas Ordnance Plant. This plant is operated by J-M Service Corp., a subsidiary of Johns-Manville.

VIKING

...AN OLD-TIMER *Every* NEWCOMER SHOULD KNOW

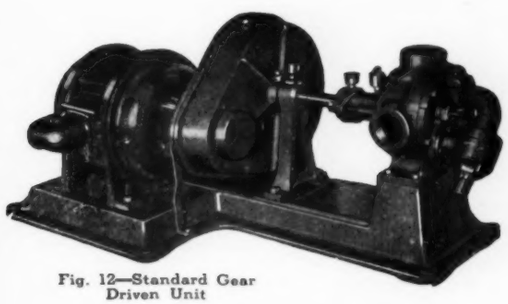


Fig. 12—Standard Gear Driven Unit

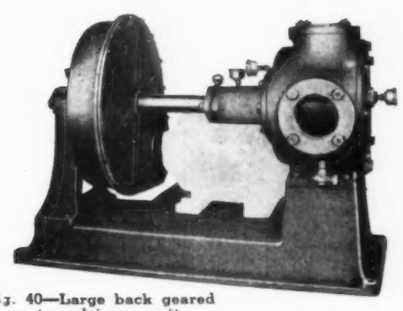


Fig. 40—Large back geared motor driven unit.

☆

LEST YOU FORGET....

When ordering pumps or parts it is necessary to give us your priority rating and allocation symbol. Be sure to obtain the highest rating possible. Priority regulations are changed frequently. Check up and see if changes made improve your rating. Thank you.

VIKING PUMPS — FIRST IN AMERICA

Specify VIKINGS for your rotary pump equipment and make sure of dependable, trouble-free service. That's the goal of every man, new or old, in today's big battle of production. More than a million Viking Rotary Pumps are delivering top-notch production on the toughest kinds of jobs all over the world today. That is the best testimonial to Viking's simple design with only two moving parts; to Viking's sturdy, high-quality construction. For complete information write today for a free copy of Bulletin 802, which illustrates and describes Viking models, capacities, mounting styles and other specifications.

VIKING Pump COMPANY
CEDAR FALLS, IOWA

Goodbye Defense
... HELLO 1943!

Gone are the days when we wondered where the enemy would strike next. Instead, the New Year is as the dawn of a new day. It brings great promise of a strong offensive such as only a country of our might can launch.

We find the Yanks once again are on the march.

We feel that 1943 will be a fascinating year. Despite rationing, shortages and other difficulties which have become part of the Nation's habit, we know the Oil Industry will continue to successfully supply the armed forces till victory.

REPUBLIC

(One of a series)

OIL is Ammunition

Use it Wisely

REPUBLIC OIL CO.

BENEDUM TREES BLDG. PITTSBURGH, PA.

THE INDEPENDENT SUPPLIER TO THE INDEPENDENT MARKETER

COMING MEETINGS

JANUARY

Kansas Oil Men's Assn., Annual Meeting, Hotel Broadview, Wichita, Kans., Mon., Jan. 18

Oil Trades Assn. of New York, Inc., Waldorf-Astoria Hotel, New York, Tues., Jan. 19.

Wisconsin Petroleum Assn., Hotel Schroeder, Milwaukee, Wed.-Thurs., Jan. 20-21.

North Carolina Oil Jobbers Assn., Hotel Carolina, Raleigh, N. C., Wed., Jan. 20.

Oil Trade Assn. of Philadelphia, Bellevue-Stratford Hotel, Philadelphia, Pa., Tues., Jan. 26.

Northwest Petroleum Assn., Annual Meeting, Radisson Hotel, Minneapolis, Minn., Thurs.-Fri., Jan. 28-29.

FEBRUARY

National Oil Scouts & Landsmen's Assn., Annual Meeting, Adolphus Hotel, Dallas, Texas, Thurs., Feb. 4.

American Institute of Mining & Metallurgical Engineers, Annual Meeting, New York, N. Y., Mon.-Thurs., Feb. 15-18.

Illinois Petroleum Marketers Assn., 1943 Victory Convention, Hotel Pere Marquette, Peoria, Ill., Wed.-Thurs., Feb. 17-18.

Iowa Independent Oil Jobbers' Assn., Hotel Fort Des Moinese, Des Moines, Ia., Wed.-Fri., Feb. 24-26.

North Texas Oil & Gas Assn., Annual Meeting, Woman's Forum, Wichita Falls, Teas, Sat., Feb. 27.

MARCH

Indiana Independent Petroleum Assn., Inc., Semi-annual Convention, Hotel Severin, Indianapolis, Ind., Tues.-Wed., March 10-11.

APRIL

American Assn. of Petroleum Geologists, 28th Annual Meeting, The Hotel Texas, Fort Worth, Texas, Tues.-Wed.-Thurs., April 7-8-9.

American Petroleum Institute, Division of Production, Eastern District, Wm. Penn Hotel, Pittsburgh, Pa., April 8-9.

The American Society of Mechanical Engineers, Hotel Blackhawk, Davenport, Iowa, Fri.-Sun., April 26-27-28.

MAY

Petroleum Industry Electrical Assn., Houston, Tex., Wed.-Thurs., May 5-6.

National Fire Protection Assn., Palmer House, Chicago, Ill., Mon.-Sat., May 10-11-12-13-14-15.

JUNE

The American Society of Mechanical Engineers, Hotel Biltmore, Los Angeles, Calif., Mon.-Wed., June 14-15-16.

OCTOBER

Petroleum Division, National Assn. of Credit Men, St. Louis, Mo., Mon.-Wed., Oct. 25-26-27.

NOVEMBER

The American Society of Mechanical Engineers, New York, Mon.-Fri., Nov. 29-30, Dec. 1-2-3.

DECEMBER

Nebraska Petroleum Marketers, Inc., Fontenelle Hotel, Omaha, Tues.-Thurs., Dec. 7-8-9.

Canfield Uses Sound Car To Promote Good Will

NPN News Bureau

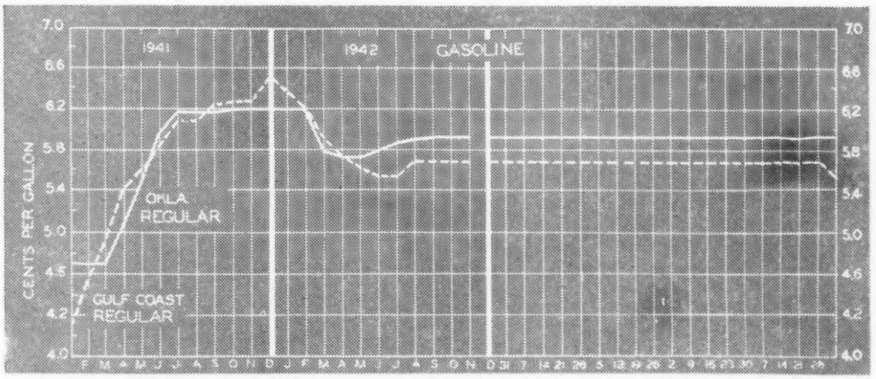
CLEVELAND—The inclusion in their advertising budget of a sound car to promote good will has been more than amply justified, officials of the Canfield Oil Co. here in Cleveland say. Their sound truck has attended hundreds of picnics, sports events, church affairs and civic holidays in the past few years, and at present is cooperating to the fullest extent with war and civilian defense programs.

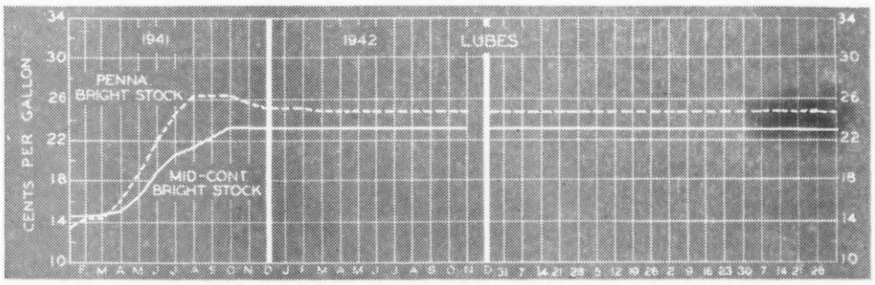
In all, the company estimates that the car reached over 4 million people during the first 6 months of this year, and A. C. Ellinger, distribution manager for Canfield, says that his company feels "that the sound car, as well as rendering a real civic service in these wartimes, has been of inestimable value in building good will for the company's service stations operating in Cleveland and Northern Ohio".

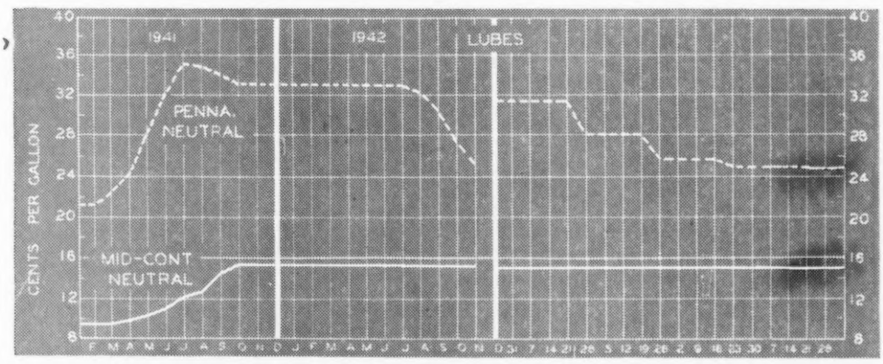
STATISTICS

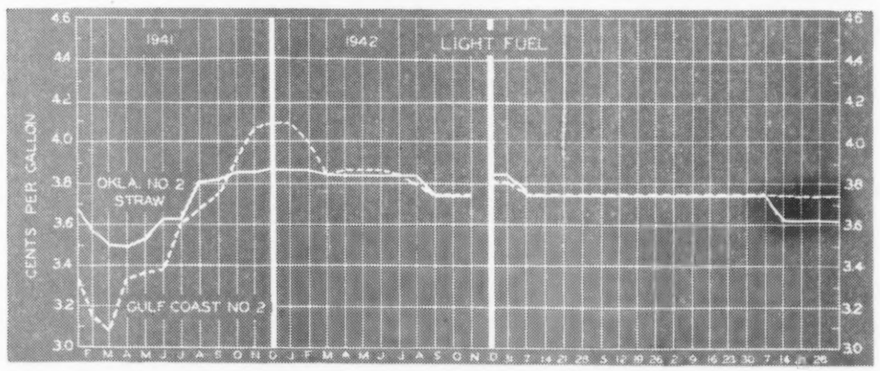
Refinery Prices

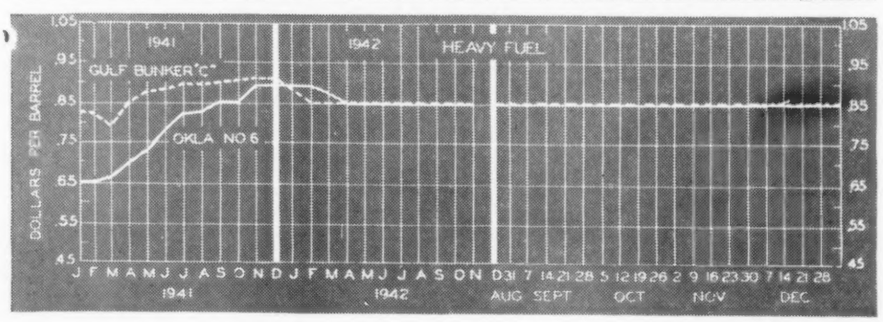
Monthly prices in graphs are averages of daily high and low prices shown in Platt's Oilgram
Weekly prices are averages of high and low prices shown in Monday Oilgram, and in NPN











Pennsylvania Lubricating Oils

(Compiled by National Petroleum Assn. from reports of all companies which refine Pennsylvania grade crude oil. Figures in bbls.)

	Production Nov. 1942	Inventory Nov. 30, 1942	Inventory Oct. 31, 1942	Inventory Nov. 30, 1941
1. Raw Long Residuum	71,809	106,529	87,028	53,831
2. 600 Steam Refined Stock	296,858	252,416	286,817	295,572
3. Other Steam Refined Stock	52,689	90,202	99,642	86,416
4. Finished Dewaxed Long Residuum	52,232	73,318	70,291	57,036
5. Bright Stock	199,417	322,382	311,985	310,259
6. Viscous Neutral	85,517	177,067	160,875	58,055
7. Viscous Neutral	77,503	318,889	325,239	72,807

Net Stocks of Pennsylvania Crude Oil

(Compiled by National Petroleum Assn. Figures in barrels.)

	Nov. 30, 1942	Oct. 31, 1942	Nov. 30, 1941
At Refineries	482,542	504,049	366,138
Pipe Line and Tank Farm	2,236,168	2,295,613	2,901,773
Total	2,718,710	2,799,662	3,267,911

Penna. Oils Other Than Lubes at Refineries

(Compiled by National Petroleum Assn. from reports of oil region refiners. Figures in barrels)

1. Naphthas & Gasoline	
(a) Straight run unblended and/or unleaded, for sale as motor fuel	10,353
(b) Naphtha and gasoline, for sale for blending or further refining, or held at refinery for further distillation, reforming, blending or leading	172,355
(c) Below 65 Octane, not included in (a) or (b) above	3,895
(d) 65 Octane and above	192,470
2. Salable Naphthas other than Motor Fuel Material (does not include Refinery Process Naphthas)	18,497
3. Kerosene	83,463
4. 36/40 Gas Oil (include Furnace Oil)	92,640
5. Fuel Oil (not reported above)	24,524
6. Oils held as Cracking Plant Charging Stocks	232,966
7. Non Viscous Neutral	50,513
8. Wax Distillate	129,719
9. Crude Petrolatum	37,381
10. Wax (lbs.)	3,774,864

Pennsylvania Crude Runs

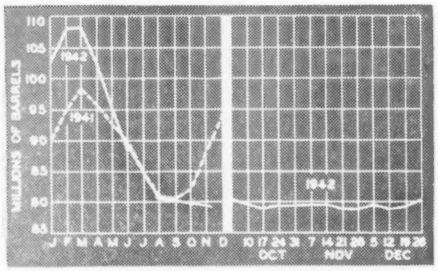
(Compiled by National Petroleum Assn. from reports of all companies which refined Pennsylvania crude. Figures in barrels.)

Week Ended	Daily Average	Week Ended	Daily Average
Jan. 3	72,172	July 4	77,973
Jan. 10	77,676	July 11	83,919
Jan. 17	81,658	July 18	84,892
Jan. 24	84,089	July 25	67,243
Jan. 31	82,603	Aug. 1	77,757
Feb. 7	74,927	Aug. 8	72,336
Feb. 14	77,436	Aug. 15	83,256
Feb. 21	82,682	Aug. 22	84,391
Feb. 28	84,173	Aug. 29	77,625
Mar. 7	80,131	Sept. 5	73,706
Mar. 14	76,862	Sept. 12	84,774
Mar. 21	79,510	Sept. 19	84,320
Mar. 28	84,185	Sept. 26	87,251
Apr. 4	78,175	Oct. 3	76,638
Apr. 11	82,557	Oct. 10	83,398
Apr. 18	82,067	Oct. 17	82,090
Apr. 25	79,353	Oct. 24	81,629
May 2	80,399	Oct. 31	82,207
May 9	80,761	Nov. 7	77,706
May 16	86,551	Nov. 14	76,766
May 23	85,563	Nov. 21	74,285
May 30	80,046	Nov. 28	76,801
June 6	83,996	Dec. 5	73,924
June 13	83,808	Dec. 12	74,263
June 20	83,648	Dec. 19	72,762
June 27	80,837	1941 Low	61,284
		1941 High	84,326

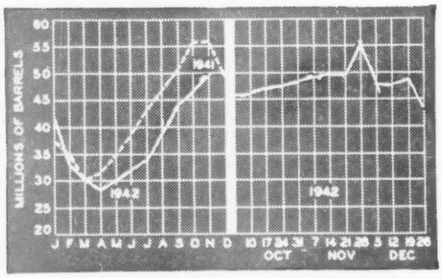
STATISTICS

Monthly figures are actual as reported by Bureau of Mines. Weekly figures are as estimated by American Petroleum Institute on Bureau of Mines basis, except crude stocks which are as reported by Bureau of Mines.

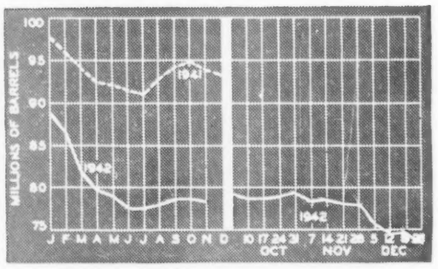
Gasoline Stocks (Finished & Unfinished)



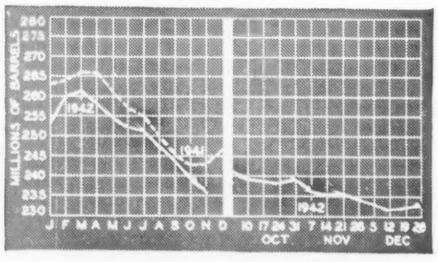
Gas Oil and Distillate Stocks



Residual Fuel Oil Stocks



Crude Stocks



Refinery Operations

(American Petroleum Institute figures in thousands of barrels of 42 gallons each. Figures include reported totals plus an estimate of unreported amounts and are therefore on a Bureau of Mines basis.)

Districts	Daily Potential Refining Capacity Week Ended Dec. 26	Daily Potential Refining Capacity Week Ended Dec. 19	Per Cent of Refining Capacity Reporting Week Ended Dec. 26	Per Cent of Refining Capacity Reporting Week Ended Dec. 19	Daily Average Crude Runs to Stills Week Ended Dec. 26	Daily Average Crude Runs to Stills Week Ended Dec. 19	Per Cent of Reporting Capacity Operated Week Ended Dec. 26	Per Cent of Reporting Capacity Operated Week Ended Dec. 19
Combined‡	2,430	2,430	88.1	88.1	1,577	1,663	64.9	68.4
Appalachian	176	176	84.8	84.8	153	149	86.9	84.7
Ind., Ill., Ky.	804	804	84.9	84.9	684	713	85.1	88.7
Okla., Kans., Mo.	416	416	80.1	80.1	341	360	82.0	86.5
Rocky Mt.	147	147	48.0	48.0	99	94	67.3	63.9
California	817	817	89.9	89.9	671	688	82.1	84.2
Total U. S.—B. of M. Basis	4,790	4,790	85.8	85.8	3,525	3,667	73.6	76.6
U. S.—B. of M. Basis Dec. 27, 1941					4,103			

Districts	Gasoline Production at Refineries inc. Natural Blended Week Ended Dec. 26	Gasoline Production at Refineries inc. Natural Blended Week Ended Dec. 19	Stocks of Finished and Unfinished Gasoline Week Ended Dec. 26	Stocks of Finished and Unfinished Gasoline Week Ended Dec. 19	Total Stocks Gas Oil & Distillates Week Ended Dec. 26	Total Stocks Gas Oil & Distillates Week Ended Dec. 19	Total Stocks Residual Fuel Oil Week Ended Dec. 26	Total Stocks Residual Fuel Oil Week Ended Dec. 19
Combined‡	4,670	4,945	36,769	36,650	22,844	24,501	13,356	14,412
Appalachian	424	386	2,741	2,693	744	358	462	529
Ind., Il., Ky.	2,203	2,139	14,636	14,094	5,606	12,706	2,049	55,509
Okla., Kans., Mo.	1,134	1,131	6,229	6,089	1,913	708	1,333	436
Rocky Mt.	297	306	1,508	1,442	354	5,699	552	2,030
California	1,492	1,968	18,345	18,163	12,338	1,908	55,210	1,289
Total U. S.—B. of M. Basis	10,220	10,875	80,228*	79,131	43,799	45,880	72,962	74,205
U. S.—B. of M. Basis Dec. 27, 1941	14,078		92,806		50,806		94,216	

*Finished 71,337,000 bbl.; Unfinished 8,891,000 bbl.

‡Includes East Coast, Inland Texas, Texas Gulf, Louisiana Gulf, and North Louisiana-Arkansas districts.

Crude Oil Stocks

(Bureau of Mines Figures in thousands of barrels)

Grade or Origin	Dec. 19	Dec. 26	Change from Dec. 19
Pennsylvania Grade	2,979	2,945	— 34
Other Appalachian	1,309	1,370	+ 61
Lima-Michigan	1,151	1,065	— 86
Illinois-Indiana	9,402	9,720	+318
Arkansas	2,093	2,192	+ 99
Kansas	7,078	7,064	— 14
Louisiana:	12,346	12,078	—268
Northern	4,657	4,630	— 27
Gulf Coast	7,689	7,448	—241
Mississippi	1,273	1,301	+ 28
New Mexico	5,701	5,720	+ 19
Oklahoma	40,116	39,469	—647
Texas:	102,830	104,043	+1,213
East Texas	24,753	25,616	+863
West Texas	24,685	24,590	— 95
Gulf Texas	28,090	28,609	+519
Other Texas	25,302	25,228	— 74
Panhandle	4,811	5,106	+295
North	7,504	7,364	—140
South	4,854	4,922	+ 68
Other	8,133	7,836	—297
Rocky Mountain	14,018	14,042	+ 24
California	32,024	32,040	+ 16
Foreign	137	178	+ 41
Total gasoline-bearing in U. S.	232,457	233,227	+770
Heavy in California	10,550	10,628	+ 78

N. P. N. Gasoline Index

	Dealer T.W. Cents Per Gallon	Tank Car Cents Per Gallon
Jan. 4	10.47	6.70
Month ago	10.47	6.66
Year ago	10.06	6.80

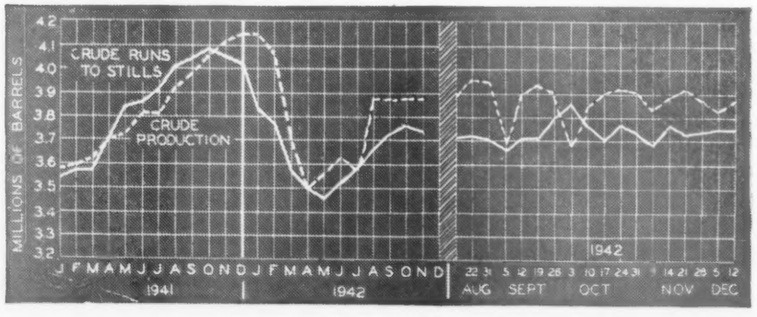
Dealer index is an average of "undivided" dealer prices, ex-tax, in 50 cities.

Tank car index is a weighted average of following wholesale markets for regular-grade gasoline, FOB refineries or terminals: Okla., Mid-Western, W. Penna., Calif., N. Y. Harbor, Philadelphia, Jacksonville, Boston and Gulf Coast.

November Mid-Continent Lube Statistics

(Figures in barrels compiled by Western Petroleum Refiners Assn.)

	Bright Stock	Viscous Neutrals	Paraffin Oils	Steam Refined Stock	Blended Oils
Production	179,337	227,778	82,369	28,826	187,755
Shipments:					
Domestic	124,179	190,357	76,335	21,074	202,091
Export	2,336	2,736	7	147	2,061
Total	126,515	194,093	76,342	21,221	204,152
Inventory					
Nov. 30	559,028	480,157	73,435	56,841	157,932
Days Supply	93	62			

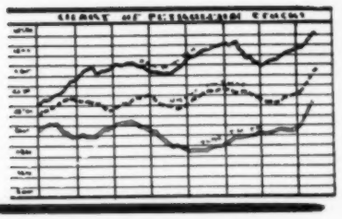


U. S. Crude Oil Production

(American Petroleum Institute figures)

	WEEK ENDED Dec. 26 Barrels (Daily Average)	WEEK ENDED Dec. 19 Barrels (Daily Average)
Oklahoma	354,850	357,150
Kansas	295,900	305,700
Nebraska	3,000	3,000
Texas	1,390,150	1,390,150
Louisiana	315,600	313,150
Arkansas	73,350	73,700
Mississippi	56,550	59,100
Illinois	234,800	239,000
Indiana	14,850	14,700
Eastern (Ill. & Ind. excluded)	87,000	88,800
Michigan	59,800	58,900
Wyoming	89,900	91,300
Montana	22,350	22,650
Colorado	6,950	6,350
New Mexico	93,350	93,350
California	782,100	774,500
Total U. S.	3,880,700	3,891,500

Oil MARKETS



Mid-Western

CHICAGO, Jan. 2 — For the past week the fuel oil market has been in disturbing condition as demand exceeds supply and few refiners have any inventories on hand. One refiner In accordance with new OPA amendment, the 0.3c raise on tank wagon prices has gone into effect among mid-western refiners.

The gasoline movement continued strong with a slight easing up towards the end of the week. Markets on practically all products have been good although one refiner reported a slow market on lubricating oils.

Central Michigan followed the general mid-western market trend. Some materials are

No price changes reported.

Atlantic Coast

NEW YORK, Jan. 2—Confusion persisted among East Coast suppliers the last week of December resulting from PAW's Petroleum Administrative Order No. 1, zone limitations of which, with their overlapping areas, were said to have upset companies' delivery organizations.

Heating oil at New York was said to be tighter at present than at any time so far this winter. Heavy fuel receipts were said to be inadequate to meet constant essential industrial demand and large-scale heating requirements. Gasoline stocks at North Atlantic points also were severely limited.

Supplier of kerosine at New Orleans lowered his quotations 0.05c to 4.45c narrowing the range, but leaving the low for that point unchanged at 4.25c. Quotations at other points were unchanged.

Pennsylvania

NEW YORK, Jan. 2—Refiners in Western Pennsylvania maintained their quotations for neutral oils the past week despite rumors of lower priced material being available and offerings of Penna. grade neutral by a mid-western sales agent at 1c off. Published reports from outside the district said 22c was being asked by refiners for 200 vis., No. 3 color, 25 P. T. Neutral, and one reseller said he no longer was getting any business on that grade at 23c because of "competition" quoting jobbers at 22c.

Inter-refinery sale of 200 Vis. at 22c was reported by a refiner who said he took neutral to get bright stock at 24.5c, 0.5c off. Refiners, however, held their quotations at 23 to 26c for 200 vis. and 21 to 24c for 150 vis.

Shipments of other refined products continued heavy, with refiners reporting gasoline, kerosine, and burning oil "still moving out very well". Industrial demand for burning oils and gasoline was said to be the prime factor in keeping inventories low.

Mid-Continent

TULSA, Jan. 2—North Texas price ranges on 2 grades of gasoline were narrowed Dec. 31, when refiner withdrew quotations, having disposal of material in storage when his refinery shut down earlier in month. Low of range for 72-74 octane was raised 0.05c to 5.8c, with others' quotations ranging upward to 6c, high of range for 63-66 dropped 0.125c to 5.5c, while low remained at 5.4c. Withdrawal of quotation for 60 and below did not affect range.

With demand for most products continuing refiners said their severest problems were shortages of transportation and crude.

"Constant pressure to make more fuel oil" was reported by most refiners, who said they were meeting it to best of ability. Some said further increase in yield of residual oil had been achieved at expense of gasoline and distillate fuels, but permission to run more crude", one commented. "doesn't mean much if you can't get the crude".

Gulf

NEW YORK, Jan. 2—Sales of gasoline and kerosine at higher quotations for several grades of gasoline were reported at the Gulf the last week of 1942.

Kerosine sale was of 35 tank cars for shipment east in buyer's cars and was made at "ceiling" price of 3.875c. Refiner who made the sale said his 2 plants were shut down for lack of storage.

Gasoline sale, of 20,000 bbls. of 68-70 octane (ASTM) unleaded, brought 5.625c for cargo lifting. Refiner had been offering grade at 5.25c and min. 80 oct. (research) at 5.5c but said he now was quoting 5.625c and 5.75c for the 2 grades, respectively. Advance raised range lows for 70 oct. and min. 80 oct. 0.25c each. New ranges were 5.75c to 6c for min. 80 oct. (research), 5.5 to 5.625c for 70 oct. (ASTM), and 5.25 to 5.625c for 68 oct. (ASTM). Quotations for other products were unchanged.

California

LOS ANGELES, Jan. 2.—Gasoline market was generally described as "sloppy" although it appeared that prices held at the same level as in the past few weeks. On the 3 grades extreme bottom remained at 6c, 5.5c, and 4.5c.

Several of the smaller independents report that their sales have shrunk from one-third to as much as two-thirds since rationing. Storage problem for gasoline is becoming a problem not only with independents but also with some majors, it is reported.

Index of Governmental Orde Concerning Petroleum Prices

Orders, "requests", "ceilings", and other statements issued by governmental agencies concerning prices of petroleum and products, prices for which are published in this market section of NATIONAL PETROLEUM NEWS, have been published as follows:

(For orders issued prior to May see NPN Nov. 25, p. 39)

	NATIONAL PETROLEUM NEWS	PLATT'S OILGRAM	Platt's OIL-Law-GRAM
May 12, '42—Maximum prices Pacific Coast area	May 20, p 7	May 14, p. 2	P. 300.18
May 26, '42—Discounts frozen at Oct. 1-15, '41 levels	June 3, p. 9	May 27, p. 1	P. 300.21
June 27, '42—East Coast advance effective June 29	July 1, p 3	June 27, p. 1	P. 300.27
June 27, '42—Service station price order widened	July 1, p. 3	June 27, p. 2	P. 272.14
July 29, '42—Basing "ceiling" prices on published Group 3 quotations	Aug. 26, p. 3	Aug. 26, p. 4	P. 300.42
Aug. 3, '42—East Coast decrease effective Aug. 5	Aug. 1, p. 1	Aug. 5, p. 3	P. 300.35
Aug. 3, '42—East Coast reduction, service station prices	Aug. 5, p 8	Aug. 1, p. 3	P. 272.20
Aug. 14, '42—Maximum prices for asphalts, Pacific Coast area	Aug. 19 p. 16	Aug. 14, p. 2	P. 300.38
Aug. 21, '42—Revision of crude price basis	Aug. 26, p. 18	Aug. 21, p. 1	P. 300.40
Aug. 29, '42—Maximum s.s. prices for Penna. lubes in Pacific Coast area	Sept. 2, p. 9	Aug. 29, p. 4	P. 272.21
Sept. 11, '42—New maximum price basis	Sept. 16, p. 6	Sept. 11, p. 1	P. 300.43
Oct. 2, '42—Retail margins permitted at Oct. 1-15, '41 level	Oct. 7, p. 29	Sept. 30, p. 1	P. 272.26
Oct. 22, '42—Prices on kerosine and other distillates produced in or shipped into Michigan	Oct. 28, p. 26	Oct. 22, p. 1	P. 300.53
Oct. 27, '42—Price increase for Lima, Ind. and Ohio crude	Oct. 28, p. 14	Oct. 27 p. 1	P. 300.56
Oct. 29, '42—Maximum prices for Oklahoma No. 6 fuel oil	Nov. 4, p. 3	Oct. 29, p. 1	P. 300.58
Nov. 6, '42—Increase in kerosine tank car prices f.o.b. Jacksonville	Nov. 11, p. 10	Nov. 6. p. 1	P. 300.61
Nov. 12, '42—Provisions for collection of new lube oil tax set up	Nov. 18, p. 9	Nov. 12, p. 1	P. 272.30 P. 300.65
Nov. 13, '42—Maximum prices for No. 2 fuel oil in Minneapolis-St. Paul area	Nov. 18, p. 9	Nov. 13, p. 2	P. 300.68
Nov. 16, '42—Revocation of Oct. 22 Michigan prices	Nov. 18, p. 9	Nov. 16, p. 2	P. 300.71
Nov. 19, '42—Maximum prices for Bunker C and No. 6 fuel oil at Mobile	Nov. 25, p.	Nov. 19, p. 1	P. 300.78

REFINERY and SEABOARD PRICES

In bulk lots by Motor Transport, Tank Car, Barge or Tanker as shown

NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.

HOW PRICES ARE REPORTED—

Refinery and Seaboard prices in National Petroleum News are gathered by PLATT'S OILGRAM and are published in the Monday issue of the OILGRAM.

PLATT'S OILGRAM is a reporting service issued in three identical editions daily from News Bureaus at New York, Cleveland, and Tulsa, Okla. PLATT'S OILGRAM gathers and publishes what its publisher and representatives believe to be accurate news of sales, prices and current happenings affecting the oil industry and that will be of interest to its subscribers. As this information is usually private, OILGRAM reports it according to what it is able to obtain from sources deemed reliable.

All information is supplied without guarantee as to its completeness, accuracy, time of transmission or promptness of delivery.

The subscriber receives this information for his private use and not for resale or further distribution.

Publisher reserves the right to change the extent, nature and form of showing this information at any time.

Prices shown in the tables are quotations (meaning sellers' general offers or posted prices), or actual sales prices, reported to OILGRAM by refiners for "open spot" transactions, except as otherwise specified.

Prices arrived at by discounts off a specified price or "market date of shipment," prices named in contracts or prices arrived at in accordance with any arrangement made prior to date of sale, are not for "open spot" transactions and therefore are not considered in making the price tables. Prices made to brokers and prices in "Inter-refinery" transactions are also not considered except as may be noted.

All prices are for "immediate" shipment except in Gulf Coast bulk transactions where shipment is generally to be made in ninety days. Prices are FOB refineries, pipelines, or tanker terminals in districts designated.

Prices shown are for quantities in bulk such as tank car lots, motor transport lots or barge lots; and in cents per gallon; heavy fuel oils are in dollars per barrel of 42 U.S. gallons; wax and petrolatums are in cents per pound. Prices applying to barges or cargoes only are so designated.

Prices do not include taxes or inspection fees. Prices are published at the close of the business day.

Mid-Western prices in the tables were gathered from refiners with offices located in Chicago and the surrounding territory. While the prices are quoted on a Group 3 (Oklahoma) freight basis, this is in accordance with the custom of the oil industry which uses Group 3 as a price basis for the ease of comparing prices even when the material originates in another refining district. Other refinery prices are given by and for the particular refining district where the material is made and from which it is shipped.

When prices obtained by OILGRAM do not conform to these conditions the exception and the new conditions are noted in the news lead or in conjunction with the price table by footnote or otherwise, for the particular refinery or sales district involved.

Crude oil and products covered by OILGRAM'S news and price service, except where noted, have been represented to the publisher as fully up to the customary trade specifications indicated and according to the generally accepted methods of test: and all crude oil and all products thereof as having been lawfully produced and transported.

Any apparent error should be reported to the nearest OILGRAM or National Petroleum News office at once as no correction will be made after the second issue of the OILGRAM or National Petroleum News following its publication.

NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids, though higher, from others. Refiners' prices and sales shown; bids reported in market leads.

Summary of Daily Gasoline Prices (Dec. 28 to Jan. 4)

	Monday Jan. 4	Thursday Dec. 31	Wednesday Dec. 30	Tuesday Dec. 29
U. S. Motor, (ASTM octane)				
78 octane Ethyl:				
Oklahoma	6.75 – 6.875	6.75 – 6.875	6.75 – 6.875	6.75 – 6.875
Mid-Western (Group 3 basis)	6.75 – 7.125	6.75 – 7.125	6.75 – 7.125	6.75 – 7.125
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6.6 – 7	6.6 – 7	6.6 – 7	6.6 – 7
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7 (2)	7 (2)	7 (2)	7 (2)
72-74 octane:				
Oklahoma	5.875– 6	5.875– 6	5.875– 6	5.875– 6
Mid-Western (Group 3 basis)	5.875– 6	5.875– 6	5.875– 6	5.875– 6
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.8 – 6	5.8 – 6	5.75 – 6	5.75 – 6
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6
63-66 octane:				
Oklahoma	5.5 – 5.625	5.5 – 5.625	5.5 – 5.625	5.5 – 5.625
Mid-Western (Group 3 basis)	5.5–5.625	5.5–5.625	5.5 – 5.625	5.5 – 5.625
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.4 – 5.5	5.4 – 5.5	5.4–5.625 (a)	5.4–5.625 (a)
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.75(1)	5.75 (1)	5.75(1)	5.75 (1)
60 octane & above:				
Oklahoma	5.125– 5.25	5.125– 5.25	5.125– 5.25	5.125– 5.25
Mid-Western (Group 3 basis)	5.1 – 5.25	5.1 – 5.25	5.1 – 5.25	5.1 – 5.25
N. Tex. (For shpt. to Tex. & N.M. dest'ns.)	4.875– 5.25	4.875– 5.25	4.875– 5.25	4.875– 5.25
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.25	5.25	5.25	5.25
Motor Gasoline, 72-74 octane (ASTM)				
New York harbor	9.2 –10.2	9.2 –10.2	9.2 –10.2	9.2 – 10.2
New York harbor, barges	9.1 – 9.2	9.1 – 9.2	9.1 – 9.2	9.1 – 9.2
Philadelphia district	9.2 – 9.7	9.2 – 9.7	9.2 – 9.7	9.2 – 9.7
Baltimore district	8.95	8.95	8.95	8.95
Motor Gasoline:				
Western Penna. Bradford-Warren:				
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.5–7.75 (2)	7.5–7.75 (2)	7.5–7.75 (2)	7.5–7.75 (2)
Western Penna. Other Districts:				
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.25 – 7.3	7.25 – 7.3	7.25 – 7.3	7.25 – 7.3

REFINERY PRICES

Gasoline—U. S. Motor (ASTM) except where otherwise specified

Prices in Effect	Jan. 4	Dec. 28
OKLAHOMA		
78 oct. Ethyl	6.75 – 6.875	6.75 – 6.875
72-74 oct.	5.875– 6	5.875– 6
63-66 oct.	5.5 – 5.625	5.5 – 5.625
60 oct. & below	5.125– 5.25	5.125– 5.25
60-62, 400 e.p.	5.125 (1)	5.125 (1)
MID-WESTERN (Group 3 basis)		
78 oct. Ethyl	6.75 – 7.125	6.75 – 7.125
72-74 oct.	5.875– 6	5.875– 6
63-66 oct.	5.5 – 5.625	5.5 – 5.625
60 oct. & below	5.1 – 5.25	5.1 – 5.25
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
78 oct. Ethyl	6.6 – 7	6.6 – 7
72-74 oct.	5.8 – 6	5.75 – 6
63-66 oct.	5.4 – 5.5	5.4 – 5.625
60 oct. & below	4.875– 5.25	4.875– 5.25
60-62, 400 e.p.	5.375 (1)	5.375 (1)
W. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
78 oct. Ethyl	7 (2)	7 (2)
72-74 oct.	6	6
63-66 oct.	5.75 (1)	5.75 (1)
60 oct. & below	5.25	5.25
CENT. W. TEX. (Prices to truck transports)		
80 oct. & above	7 (2)	7 (2)
72-74 oct.	5.875 (2)	5.875 (2)
67-69 oct.	5.375 (1)	5.375 (1)
62 oct. & below	5.125 (2)	5.125 (2)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
60 oct. & below	No Price	No Price
60-62, 400 e.p.	No Price	No Price
KANSAS (For Kansas destinations only)		
78 oct. Ethyl	7.25 (1)	7.25 (1)
72-74 oct.	6 –6.2 (2)	6 –6.2 (2)
63-66 oct.	5.625–5.8 (2)	5.625–5.8 (2)
60 oct. & below	5.25 –5.4 (2)	5.25 –5.4 (2)

Prices in Effect	Jan. 4	Dec. 28
ARK. (For shipment to Ark. & La.)		
72-74 oct., leaded	6 (1)	6 (1)
70-72 oct. "	5.875 (1)	5.875 (1)
62 oct. "	5.5 (1)	5.5 (1)
60 oct. & below, unleaded	5.375 (1)	5.375 (1)
WESTERN PENNA. (Motor gasoline)		
Bradford-Warren:		
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.5–7.75 (2)	7.5–7.75 (2)
Other districts:		
"Q" Gasoline Min. 70 Oct. (ASTM)	7.25 – 7.3	7.25 – 7.3
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
U.S. Motor: (Oct. ASTM):		
72-74 oct.	8 – 8.5	8 – 8.5
67-69 oct.	7.5 (1)	7.5 (1)
Str. run gasoline, excluding Detroit shpt.	5 – 6	5 – 6
OHIO (S. O. Ohio quotations for statewide delivery and subject to exceptions for local price disturbances)		
72-74 oct.	8.375	8.375
CALIFORNIA U.S. Motor:		
78 oct. & above (Ethyl)	6 – 8.75	6 – 8.75
70-75 oct. (regular)	5.5 – 7.75	5.5 – 7.75
65 oct. & below (3rd grade)	4.5 – 6.75	4.5 – 6.75

Kerosine, & Gas Fuel Oils

Prices in Effect	Jan. 4	Dec. 28
OKLAHOMA		
41-43 grav. w.w.	4.375– 4.5	4.375– 4.5
42-44 grav. w.w.	4.5	4.5
Range Oil	4 – 4.125	4 – 4.125
No. 1 P.W.	3.875	3.875
No. 1 straw	3.875– 4 (1)	3.875– 4 (1)
No. 2 straw	3.625	3.625
No. 3 fuel	3.5 (2)	3.5 (2)
U. G. I. Gas Oil	3.625–3.75 (1)	3.625–3.75(1)
No. 6 fuel	$0.80-$0.90(2)	$0.80-$0.90(2)
14-16 fuel	$0.95 (1)	$0.95 (1)
MID-WESTERN (Group 3 basis)		
41-43 grav. w.w.	4.375	4.375
42-44 grav. w.w.	4.5 (2)	4.5 (2)
Range Oil	4	4
No. 1 p.w.	3.875	3.875
No. 2 straw	3.625	3.625
No. 3	3.5	3.5
No. 5	$0.85 (1)	$0.85 (1)
No. 6	$0.80	$0.80
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
41-43 grav. w.w.	4.25– 4.75	4.25 – 4.75
No. 1 P.W.	4.1 –4.2 (2)	4.1 –4.2(2)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
41-43 grav. w.w.	No Price	No Price
No. 1 straw	No Price	No Price
KANSAS (For Kansas destinations only)		
41-43 grav. w.w.	No Price	No Price
42-44 grav. w.w.	4.7 –4.875(2)	4.7 –4.875 (2)
No. 1 p.w.	4.1 –4.25 (2)	4.1–4.25 (2)
No. 6 fuel	$0.85 (a)	$0.85 (a)

(a) This price correct for Dec. 16 issue also.

REFINERY PRICES (Continued)

(NOTE--Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.)

NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids, though higher, from others. Refiners' prices and sales shown; bids reported in market leads.

Kerosine, & Gas Fuel Oil

(Cont'nued)

Prices in Effect	Jan. 4	Dec. 28
ARK. (For shipment to Ark. and La.)		
41-43 grav. w.w.	4.625 (1)	4.625 (1)
No. 1	4 (1)	4 (1)
No. 2	3.5 (1)	3.5 (1)
No. 3 fuel	3.5 (1)	3.5 (1)
Tractor fuel, for shpt. to Ark. points only	5.125 (1)	5.125 (1)
WESTERN PENNA.		
Bradford-Warren:		
45 grav. w.w.	6.25 – 7.75	6.25 – 7.75
46 grav. w.w.	6.25 (1)	6.25 (1)
No. 1 fuel	6.25 – 7.75	6.25 – 7.75
No. 2 "	6.25 – 7.625	6.25 – 7.625
No. 3 "	6.25 –7.75	6.25–7.75
36-40 gravity	6.25 –6.5 (2)	6.25–6.5 (2)
Other districts:		
45 grav. w.w.	6.125– 7.625	6.125– 7.625
46 grav. w.w.	6.125– 6.25	6.125– 6.25
47 grav. w.w.	6.25 – 6.375	6.25 – 6.375
No. 1 fuel	5.875– 6	5.875– 6
No. 2 "	5.875– 7.125	5.875– 7.125
No. 3 "	5.875– 7.125	5.875– 7.125
36-40 grav., Pittsburgh dist. prices excluded	5.875– 7	5.875– 7
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
47-49 gravity w.w.	5.8 – 6	5.8 – 6
P.W. Distillate	5.5	5.5
No. 3 gas oil, Straw.	5	5
U.G.I. gas oil	4.5 (2)	4.5 (2)
Fuel Oils (Vis. at 100).		
300-500 Vis.	....	....
100-300 Vis.	4.5	4.5
OHIO (S. O. quotations for statewide delivery)		
Kerosine	7	7
CALIFORNIA		
40-43 grav. w.w.	4.5 – 7	4.5 – 7
San Joaquin Valley:		
Heavy fuel	$0.85 (2)	$0.85(2)
Light fuel	$0.95 (2)	$0.95 (2)
Diesel fuel	4 (2)	4 (2)
Stove dist.	3 – 5 (2)	3 – 5 (2)
Los Angeles:		
Heavy fuel	$0.80–0.85 (2)	$0.80–0.85 (2)
Light fuel	$0.85–0.95 (2)	$0.85–0.95 (2)
Diesel fuel	3 – 5 (2)	3 – 5 (2)
Stove dist.	3 – 5 (2)	3 – 5 (2)
San Francisco:		
Heavy fuel	$0.90 (1)	$0.90 (1)
Light fuel	$1.00 (1)	$1.00 (1)
Diesel fuel	4.5 (1)	4.5 (1)
Stove dist.	5.5 (1)	5.5 (1)

Note: All above heavy fuels meet Pacific specification 400; light fuel, spec. 300; Diesel fuels, spec. 200; and stove distillate, spec. 100.

Lubricating Oils

WESTERN PENNA.

Prices are for sales made, or offers reliably reported, to jobbers & compounders only.

Viscous Neutrals—No. 3 col. Vis. at 70°F.

200 Vis. (180 at 100°) 420-425 fl.		
0 p.t.	31.5 (1)	31.5 (1)
10 p.t.	30.5 (1)	30.5 (1)
15 p.t.	29.5 (1)	29.5 (1)
25 p.t.	23–26	23–26
150 Vis. (143 at 100°) 400-405 fl.		
0 p.t.	29.5 (1)	29.5 (1)
10 p.t.	28.5 (1)	28.5 (1)
15 p.t.	27.5 (1)	27.5 (1)
25 p.t.	21–24	21–24
Cylinder Stocks		
Brt. stk., 145-155 vis. at 210°, 540-550 fl., No. 8 col.		
10 p.t.	30.5 (1)	30.5 (1)
15 p.t.	29.5 (1)	29.5 (1)
25 p.t.	25	25
600 S.R. filterable	15	15
650 S.R.	15.5	15.5
600 fl.	16	16
630 fl.	17	17

MID-CONTINENT (F. o. b. Tulsa)

Neutral Oils (Vis. at 100° F. 0 to 10 P.P.)

Pale Oils:

Vis. Color		
60-85—No. 2	8	8
86-110—No. 2	8.5	8.5
150—No. 3	14.5	14.5
180—No. 3	15	15
200—No. 3	15	15
250—No. 3	16–16.5	16–16.5
280—No. 3	17	17
300—No. 3	18	18

Lubricating Oils (Cont'd)

Prices in Effect	Jan. 4	Dec. 28
Red Oils:		
180—No. 5	15 (1)	15 (1)
200—No. 5	15 (1)	15 (1)
280—No. 5	No Price	No Price
300—No. 5	17.5 (2)	17.5 (2)

Note: Viscous Neutrals, 15-25 p.p. generally are quoted 0.5c under 0-10 p.p. oils. Non-viscous oils, 15-25 p.p.; generally are quoted 0.25c under 0-10 p.p. oils.

Bright Stock—Vis. at 210°		
200 Vis. D	27 (1)	27 (1)
150-160 Vis. D:		
0 to 10 p.p.	23	23
10 to 25 p.p.	22.5–23	22.5–23
25 to 40 p.p.	23 (1)	23 (1)
150-160 Vis. E	22 (2)	22 (2)
120 Vis. D:		
0 to 10 p.p.	22 (2)	22 (2)
600 S.R. Dark Green	8.5 (1)	8.5 (1)
600 S.R. Olive Green	10–11	10–11
631 S.R.	18.5 (1)	18.5 (1)
Black Oil	5.5 (1)	5.5 (1)

SOUTH TEXAS Neutral Oils

Vis. Color		
Pale Oils: (*Vis. at 100°F.*)		
100 No. 1½-2½	6.5	6.5
200 No. 2-3	8.75	8.75
300 No. 2-3	9.25	9.25
500 No. 2½-3½	10	10
750 No. 3-4	10.25	10.25
1200 No. 3-4	10.375	10.375
2000 No. 4	10.5	10.5
Red Oils:		
100 No. 5-6	6.5 (2)	6.5 (2)
200 No. 5-6	8.75	8.75
300 No. 5-6	9.25	9.25
500 No. 5-6	10	10
750 No. 5-6	10.25	10.25
1200 No. 5-6	10.375	10.375
2000 No. 5-6	10.5–11.5	10.5–11.5

CHICAGO (From Mid-Continent p.l. crude.)

Neutral oils (Vis. at 100° F. 0 to 10 p.p.)

Pale Oils

Vis. Color		
60-85—No. 2	9.5 (1)	9.5 (1)
86-110—No. 2	10 (1)	10 (1)
150—No. 3	15.5 (1)	15.5 (1)
180—No. 3	16 (1)	16 (1)
200—No. 3	16 (1)	16 (1)
250—No. 3	17 (1)	17 (1)
Red Oils:		
180—No. 5	16 (1)	16 (1)
200—No. 5	16 (1)	16 (1)
250—No. 5	17 (1)	17 (1)
280—No. 5	18 (1)	18 (1)
300—No. 5	18.5 (1)	18.5 (1)

Note: Viscous oils, 15 to 30 p.p. are quoted 0.5c lower; 60-85 and 86-110 No. 2 non-viscous oils, 15 to 30 p.p., 0.25c lower.

Unfiltered Steam Refined: (Viscosity at 210°)		
140	11.5 (1)	11.5 (1)
160	12.5 (1)	12.5 (1)
200	13.5 (1)	13.5 (1)
Bright stocks, 160 vis. at 210 No. 8 color:		
0 to 10 p.p.	24 (1)	24 (1)
15 to 25 p.p.	23.5 (1)	23.5 (1)
30 to 40 p.p.	21.5 (1)	21.5 (1)
E filtered Cyl. Stock	15.5 (1)	15.5 (1)

Note: To obtain prices delivered in Chicago, add 0.25c per gal.

Natural Gasoline

(Group 3 & Breckenridge prices are to blenders on freight basis shown below. Shipments may originate in any Mid-Continent manufacturing district.)

FOB GROUP 3		
Grade 26-70	3.875 (Qtns.)	3.875 (Qtns.)
FOB BRECKENRIDGE		
Grade 26-70	3.5 (Qtns.)	3.5 (Qtns.)
CALIFORNIA (FOB plants in Los Angeles basin)		
21 pound vapor pressure for blending	4.75 – 5.375	4.75 – 5.375

Naphtha and Solvent

Prices in Effect	Jan. 4	Dec. 28
(FOB Group 3)		
Stoddard solvent	6.625	6.625
Cleaners' naphtha	7.125	7.125
V. M. & P. naphtha	7.125	7.125
Mineral spirits	6.125	6.125
Rubber solvent	7.125	7.125
Lacquer diluent	7.375– 8.125	7.375– 8.125
Benzol Diluent	8.375– 8.625	8.375– 8.625
WESTERN PENNA.		
Bradford-Warren District:		
Stoddard Solvent	7.5 (1)	7.5 (1)
Other Districts:		
Untreated naphtha	7 (2)	7 (2)
Stoddard solvent	7 – 7.25	7 – 7.25
OHIO (S. O. quotations for statewide delivery):		
V.M.&P. naphtha, D.C. naphtha, Varnolene & Sohio solvent	10	10
Rubber solvent	9	9

Wax

White Crude Scale:

WESTERN PENNA. (Bbls. C.L.)		
122-124 A.m.p.	4.25 (2)	4.25 (2)
124-126 A.m.p.	4.25	4.25
OKLAHOMA (C.L., FOB Refinery)		
Semi-refined:		
128 AMP min., white, 50 kilo bags	No Price	No Price
132-134 AMP, bbls.	5.25 (1)	5.25 (1)

CHICAGO (FOB Chicago district refinery of one refiner, in bags, carloads. Carloads, slabs loose 0.4c less. Melting points are EMP (ASTM) methods; add 3° to convert into AMP.)

Fully refined:		
122-124 (bags only)	5.6	5.6
125-127	6	6
127-129	6.25	6.25
130-132	6.55	6.55
132-134	6.8	6.8
135-137	7.55	7.55

Petrolatums

WESTERN PENNA. (Bbls., carloads; tank cars, 0.5c per lb. less.)		
Snow White	6.125– 7.25	6.125– 7.25
Lily White	5.375– 6.125	5.375– 6.125
Cream White	4.375– 5.125	4.375– 5.125
Light Amber	3.375– 3.875	3.375– 3.875
Amber	3.125– 3.5	3.125– 3.5
Red	3 – 3.25	3 – 3.25

Group 3 Freight Rates

To Division Headquarters Points of Standard Oil Co. of Indiana (Cents Per Gal.)

	Gasoline Kerosine	*Distillate Fuel Oil	Gas Oil and or Residual Fuel Oil
Chicago, Ill.	2.508	2.508	2.516
Decatur, Ill.	2.244	2.244	2.442
Joliet, Ill.	2.508	2.508	2.516
Peoria, Ill.	2.310	2.310	2.442
Quincy, Ill.	2.178	2.178	2.294
Indianapolis, Ind.	2.640	3.034	3.034
Evansville, Ind.	2.442	2.886	2.886
South Bend, Ind.	3.135	3.135	3.330
Detroit, Mich.	4.290	3.996	3.996
Grand Rapids, Mich.	3.828	3.828	3.922
Saginaw, Mich.	4.290	4.144	4.144
Green Bay, Wis.	2.838	2.838	3.182
Milwaukee, Wis.	2.706	2.706	2.738
La Crosse, Wis.	2.574	2.574	2.886
Minneapolis-St. Paul	2.574	2.574	2.886
Duluth, Minn.	2.838	2.838	3.256
Mankato, Minn.	2.574	2.574	2.886
Des Moines, Ia.	2.046	2.046	2.294
Davenport, Ia.	2.310	2.310	2.442
Mason City, Ia.	2.376	2.376	2.664
St. Louis, Mo.	2.046	2.046	2.072
Kansas City, Mo.	1.518	1.518	1.776
St. Joseph, Mo.	1.518	1.518	1.776
Fargo, N. D.	3.564	3.564	3.996
Huron, S. D.	3.036	3.036	3.330
Wichita			
From Ponca City	0.528	0.528	0.592
From Tulsa	0.858	0.858	0.962
From Cushing	0.792	0.792	0.888

*Not suitable for illuminating purposes

SEABOARD PRICES EXPORT AND COASTWISE

(NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.)

NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids though higher from others. Refiners' prices and sales shown; bids reported in market leads

Atlantic Coast

(Prices are of refiners, FOB their refineries & their tanker terminals, & of tanker terminal operators FOB their terminals)—Prices In Effect Jan. 4

MOTOR GASOLINE

District:	Min. 80 Oct. '39 Research (Max. 2 cc Lead)	72-74 Oct. (ASTM)	68-70 Oct (ASTM)
N. Y. Harb.	9.8 (1)	9.2 - 10.2	9.2 (1)
N. Y. Harb., barges	9.7 (1)	9.1 - 9.3	9.1 (1)
Albany	....	9.3 - 9.5	....
Philadelphia	....	9.2 - 9.7	9.2 (1)
Baltimore	....	8.95	8.85 (1)
Norfolk	....	8.7 - 8.95	8.5 (2)
Wilmington, N. C.	....	8.7 - 8.8	8.4-8.5 (2)
Charleston	....	8.7 -8.8 (2)	8.1 (1)
Savannah	....	8.25 - 8.75	....
Jacksonville	....	8.275 (2)	....
Miami	....	....	....
Tampa	....	8.275- 8.4	8 -8.275 (2)
Pensacola	....	7 -7.2 (1)	6.6 -6.8 (1)
Mobile	....	7 -7.9	6.6 -6.8 (1)
New Orleans	....	6.25 -6.75	....
Portland	....	9.5 -9.65	....
Boston	....	9.4 -9.7	9.7 (1)
Providence	....	9.4 -9.7	....

FUEL OILS

	KEROSINE and/or NO. 1 FUEL	No. 2	No. 3	No. 5	No. 6
N. Y. Harb.	6.8	6.7	6.7	$1.95-2.10 (a)	$1.65
N. Y. Harb., barges	6.7	6.6	6.6	....	....
Albany	7	6.8	6.8 (2)	$2.25 (1)	$1.85 (1)
Philadelphia	6.9	6.7	6.7	$1.98	$1.65
Baltimore	6.9	6.7	6.7	....	$1.65
Norfolk	6.8	6.7	6.7 (1)	....	$1.65 (2)
Wilmington, N. C	6.75	6.7	....	....	....
Charleston	6.9	6.7 (2)	....	....	$1.60 (2)
Savannah	6.75 (2)	....	....	....	$1.60 (1)
Jacksonville	6.5-6.75 (2)	6.25	....	....	$1.60 (1)
Miami	6.75 (1)	....	....	....	....
Tampa	6.75	6.25 (2)	....	....	$1.55 (1)
Pensacola	4.8 (1)	....	....	....	....
Mobile	4.75 (2)	....	....	....	....
New Orleans	4.25 - 4.45	3.75 -3.875 (2)	....	$1.25 (1)	$0.85 (1)
Portland	7	6.8	6.8 (2)	$2.25 (1)	$1.65 (1)
Boston	6.9	6.7	6.7 (2)	$1.95 (2)	$1.65
Providence	6.9	6.7	6.7 (2)	$1.90-$1.95 (2)	$1.65

(a) This price is for a straight-run low pour test No. 5 fuel.

	Bunker C Fuel: Ships' bunker (Ex Lighterage)	Diesel Oil Ships' bunkers (Ex Lighterage)	Diesel Oil Shore Plants	Gas Hous Gas Oil 28-34 Gravity
N. Y. Harbor	$1.65	$2.78	6.7-6.8 (2)	6.8 (2)
Albany	$1.85 (1)	$2.98 (1)	6.8 (1)	7 (1)
Philadelphia	$1.65	$2.78	....	....
Baltimore	$1.65	$2.78	6.7 (1)	6.7 (1)
Norfolk	$1.65	$2.78	6.7 (1)	6.7 (1)
Charleston	$1.60	$2.78 (2)	6.7 (1)	6.7 (1)
Savannah	$1.60 (1)	$2.62 (1)	....	....
Jacksonville	$1.60 (2)	$2.62 (2)	....	....
Tampa	$1.55 (2)	$2.62 (2)	....	....
New Orleans	$0.85	$1.65 (2)	3.75 (1)	....
Portland	$1.65 (1)	$2.86 (2)	6.8 (1)	6.9 (1)
Boston	$1.65	$2.78	6.7 (2)	6.8 (2)
Providence	$1.65	2.78 (2)	6.7 (1)	6.8 (1)

Wax

(Melting points are AMP 3° higher than EMP. Prices are FOB refinery and do not include bag. freight or export differentials).

Prices In Effect Jan. 4

Crude Seal	New Orleans Export	N. Y. Domestic	N. Y. Export
124-6 Yellow	4.25(1)	....	4.25 (1
122-4 White	....	4.25(2)	4.25 (2)
124-6 White	4.25(1)	4.25	4.25
Fully Refined:			
123-5	5.2 (1)	5.2 (2)	5.2 (1)
125-7	5.2 (1)	5.2 (2	5.2 (1)
128-30	5.6 (1)	5.6	5.6 (1)
130-32	5.85 (1)	5.85 (2)	5.85 (1)
133-5	6.15 (1)	6.15	6.15 1)
135-7	6.4 (1)	6.4 (1)	6.4 (1

Naphtha

Prices in Effect Jan. 4

	V.M.&P. Naphtha	Mineral Spirits
New York Harbor	11 (2)	10
Philadelphia district	11 (2)	10
Baltimore	10.5 (2)	9.5
Boston	11.5 (2)	10.5
Providence	11.5 (1)	10.5 (2)

Pacific Export

(Quotations at seaboard, Los Angeles, cargo lots, except where otherwise noted.)

Prices in Effect	Jan. 4	Dec. 28
375 e.p. blend, 70 oct.	No Price	No Price
390 e.p. blend, 68 oct.	No Price	No Price
390 e.p. blend, 66 oct.	No Price	No Price
400 e.p. blend, 65 oct. min.	No Price	No Price
U. S. Motor, under 65 oct.	No Price	No Price
38-40 grav., w.w. kero 150 fire point	No Price	No Price
41-43 grav., w.w. kero	No Price	No Price
44-grav. w.w. kero.	No Price	No Price
Diesel fuel, 24 & above	No Price	No Price
Diesel fuel, under 24	No Price	No Price
30-34 grav. diesel (gas oil) Pac. Spec. 200	No Price	No Price
Grade C fuel, Pac. Spec. 400	No Price	No Price
In Ship's Bunkers, or deep tank lots:		
Diesel Fuel, Pac. Spec. 200	$1.40 -$1.45	$1.40 -$1.45
Grade C fuel, Pac. Spec. 400	$0.825-$0.85	$0.825-$0.85
Cased Goods: (Per case)		
375-400 e.p. blend, 65 oct. & above	No Price	No Price
400 e.p. blend under 65 oct.	No Price	No Price
U. S. Motor	No Price	No Price
40-43 grav., w.w. kero., 150 fire point	No Price	No Price
Kero., p.w.	No Price	No Price

Tanker Rates

(Approximate last paid rates, cents per bbl.; Gulf-N. Atlantic, not East of N. Y.)

Hvy. Crude & Fuel (10 to 19.9 gravity)	48
Light Crude, (30 grav. or Lighter)	43
Gasoline	40
Kerosine	40
No. 2 Fuel	42

Note: 200% *surcharge permitted on above rate by War Shipping Administration "to cover increased war time operating expenses."*

Gulf Coast

(Prices for sales made or firm offers reliably reported for sales pending in cargoes FOB ship at Gulf, for minimum of 20,000 bbls. Prices are by refiners only to other refiners, export agents, or to large tanker terminal operators at the customary trade specifications noted.)

Prices In Effect Jan. 4

Domestic

Motor Gasoline	
Min. 80 oct. '39 Research, max. 2cc lead	5.75
60-62 Gravity, Max. 400 e.p. (a)	6.25 - 6.9
72-74 oct. leaded (ASTM)	5.75
70 oct. unleaded "	5.5 - 5.625
68 oct. " "	5.5 - 5.625
65 oct. " "	5.125
60 oct. " "	5
41-43 w.w. kerosine	3.875
42-44 w.w. kerosine	3.875
No. 2 fuel	3.75
63-65 oct. leaded (ASTM)	5.35
Gas Oil—Less than ½ of 1% sulfur.	
Below 43 diesel index	3.75
43-47 " "	3.875
48-52 " "	3.875- 4
53-57 " "	4 - 4.125
58 & above diesel index	4.25
Diesel Oil, ship's bunkers (ex-lighterage)	$1.65
Bunker C, " "	$0.85
Bunker C, cargoes	$0.85

(a) 80 Oct. Ethyl (ASTM), Max. 3 CC lead.

Export

Motor Gasoline	
60-62 Gravity, Max. 400 e.p. (a)	6.25 - 6.9
72-74 oct. leaded (ASTM)	5.75
70 oct. unleaded "	5.5 - 5.625
68 oct. " "	5.5 - 5.625
65 oct. " "	5.125
60 oct. " "	5
41-43 w.w. kerosine	3.875
42-44 w.w. kerosine	3.875
No. 2 fuel	3.75
63-65 oct. leaded (ASTM)	5.35
Gas Oil—Less than ½ of 1% sulfur	
Below 43 diesel index	3.75
43-47 " "	3.875
48-52 " "	3.875- 4
53-57 " "	4 - 4.125
58 & above diesel index	4.25

(a) 80 Oct. Ethyl (ASTM), Max. 3 CC lead.

MID-CONTINENT LUBES

(At Gulf; in packages, FAS.; in bulk, FOB terminals)

Prices In Effect Jan. 4

	Steel Drums	Bulk
200 Vis. D 210 brt. stock	35 (1)	28.8 (1)
150 vis. D 210 brt. stock 0-10 p.p.	31 (1)	24.8 (1)
10-25 p.p.	....	....
100 vis. D 210 brt. stock 0-10 p.p.	....	....
10-25 p.p.	....	....
200 vis. No. 3 col. neutral: 0-10 p.p.	....	....

TANK WAGON PRICES

Commercial or consumer tank car, tank wagon, dealer, and service station prices for gasoline **do not include taxes;** *they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include 1.5c federal, and state taxes; also city and county taxes as indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect Jan. 4, 1943 as posted by principal marketing companies at their headquarters offices, but subject to later correction.*

S. O. New Jersey

Esso (*Regular Grade*)

	Consumer Tank Wagon	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
*Atlantic City, N. J.	10.2	10.7	4.5	9.4
*Newark, N. J.	10.2	10.7	4.5	9.4
Annapolis, Md.	10.55	11.05	5.5	11.2
Baltimore, Md.	9.95	10.45	5.5	10.2
Cumberland, Md.	11.35	11.85	5.5	11.7
Washington, D. C.	10.2	10.7	4.5	10.7
Danville, Va.	11.65	12.15	6.5	11.95
Norfolk, Va.	10.45	10.95	6.5	11.7
Petersburg, Va.	10.75	11.25	6.5	12.7
Richmond, Va.	10.75	11.25	6.5	12.7
Roanoke, Va.	11.95	12.45	6.5	12.2
Charleston, W. Va.	12.25	12.75	6.5	13
Parkersburg, W. Va.	11.55	12.05	6.5	12.7
Wheeling, W. Va.	11.55	12.05	6.5	13.3
Charlotte, N. C.	12.1	12.6	7.5	11
Hickory, N. C.	12.65	13.15	7.5	12
Mt. Airy, N. C.	12.5	13.0	7.5	11.2
Raleigh, N. C.	11.85	12.35	7.5	12
Salisbury, N. C.	12.15	12.65	7.5	12.4
Charleston, S. C.	10.95	11.45	7.5	....
Columbia, S. C.	11.8	12.3	7.5	....
Spartanburg, S. C.	12.5	13.0	7.5	....

	Mineral Spirits T.W.	V.M.&P. T.W.
Newark, N. J.	13	14.5
Baltimore, Md.	15.5	....
Washington, D. C.	15.5	....

Fuel Oils—T.W.	No. 1	No. 2	No. 3
Atlantic City, N. J.	9.4	8.7	8.7
Newark	9.4	8.7	8.7
Annapolis, Md.	....	8.95	....
Baltimore	9.2	8.7	8.7
Washington, D. C.	9.7	9.1	9.1
Norfolk, Va.	9.4	8.5	8.5
Petersburg	9.7	8.7	....
Richmond	9.7	8.7	8.7
Charlotte, N. C.	10	10.1	....
Hickory, N. C.	....	9.7	....
Raleigh	11	9.8	....
Charleston, S. C.	....	8.7	....
Columbia	....	9.7	....
Spartanburg	....	10.5	....

*Effective Aug. 5, '42 minimum retail resale price of 14.2c posted thru New Jersey.

Discounts:

Esso gasoline—to undivided dealers, 0.5c off dealer t.w.

Kerosine—1c off t.w. price for 25 gals. or more, under contract thru territory (Baltimore city contract not necessary) except no discount in state of New Jersey.

Naphthas—To buyers taking following quantities at one time: Newark, 2c per gal. on 200 gals. or more, less than 200 gals. 0.5c higher price; Baltimore, 2c off on 25 to 100 gals. and 3c on over 100 gals.; Washington, 2c off to contract buyers.

Socony-Vacuum Oil Co., Inc.

Socony Mobilgas (*Regular Grade*)

New York City	Com. Cons. T.W.	Undiv. Dlr. T.W.	Gasoline Taxes
Manhattan & Bronx	10.1	10.6	*5.5
Kings & Queens	10.1	10.6	*5.5
Richmond	9.7	10.2	*5.5
Albany, N. Y.	9.9	10.4	5.5
Binghamton, N. Y.	11	11.5	5.5
Buffalo	10.2	10.7	5.5
Jamestown, N. Y.	10.4	10.9	5.5
Mt. Vernon, N. Y.	10.1	10.6	5.5
Plattsburg, N. Y.	11	11.5	5.5
Rochester, N. Y.	10.8	11.3	5.5
Syracuse, N. Y.	10.5	11	5.5
Bridgeport, Conn.	10	10.5	4.5
Danbury, Conn.	10.5	11	4.5
Hartford, Conn.	10.6	11.1	4.5
New Haven, Conn.	10	10.5	4.5
Bangor, Me.	10.7	11.2	5.5
Portland, Me.	10.3	10.8	5.5
Boston, Mass.	9.9	10.4	4.5
Concord, N. H.	11.4	11.9	5.5
Lancaster, N. H.	12	12.5	5.5
Manchester, N. H.	11.3	11.8	5.5
Providence, R. I.	10	10.5	4.5
Burlington, Vt.	10.9	11.4	5.5
Rutland, Vt.	11	11.5	5.5

	Mineral Spirits T.W.	V.M.&P. T.W.
Buffalo, N. Y.	12.4	13.6
New York City	11	12
Rochester, N. Y.	13.2	14.4
Syracuse, N. Y.	14	....
Boston, Mass.	12	13
Bridgeport, Conn.	†16.3	†17.3
Hartford, Conn.	†16.3	†17.3
Providence, R. I.	13	14

Effective Dec. 29, 1942

	Kerosine Yard	Kerosine TW	Mobilfuel Diese TC	Mobilfuel Diese TW	Mobilheat Fuel Yard	Mobilheat Fuel TW
New York:						
Manhat'n & Bronx	7.1	9.8	....	9.3	7	9
Kings & Queens	7.1	9.8	....	9.3	7	9
Richmond	7.1	9.8	....	....	6.9	8.8
Albany	7.2	9.5	7	9.3	7	9
Binghamton	8.6	10.9	....	10.7	8.4	10.2
Buffalo	8.3	10.6	8	10.3	8.2	10
Jamestown	8.4	10.7	....	10.6	8.3	10
Mt. Vernon	7.2	10	....	9.4	7.1	9
Plattsburg	7.8	10.1	....	9.9	7.6	9.6
Rochester	8.4	10.7	7.9	10.2	7.9	9
Syracuse	8.2	10.5	7.8	10.1	7.8	9.6
Conn.:						
Bridgeport	7.3	9.6	....	....	7.2	8.8
Danbury	7.8	10.1	....	....	7.5	8.8
Hartford	7.4	9.7	....	9.5	7.2	9
New Haven	7.1	9.4	....	9.3	7	8.9
Maine:						
Bangor	....	....	7.4	9.7	7.4	9.1
Portland	7.2	9.9	7	9.3	7	9
Mass.:						
Boston	7.3	9.8	6.9	9.2	7.1	9
N. H.:						
Concord	8.1	10.1	....	....	8.2	10
Lancaster	9.2	11.5	....	....	9.2	11
Manchester	8.2	10.8	....	....	7.9	9.7
R. I.:						
Providence	7.3	9.6	6.9	9.2	7.1	8.9
Vermont:						
Burlington	7.8	10.1	7.5	9.8	7.5	9.2
Rutland	8	10.3	....	10	7.7	9.5

*Does not include 1% city sales tax applicable to price of gasoline (ex tax).

†In steel barrels.

Discounts: Diesel—On t.w. deliveries, 0.5c for at least 400 gals.; 1c for full tank truck.

Atlantic Refining

Atlantic White Flash Gasoline (*Regular Grade*)

	Commercial T.W.	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
Philadelphia, Pa.	10.2	10.7	5.5	11.65
Pittsburgh	10.7	11.2	5.5	12
Allentown	10.7	11.2	5.5	12
Erie	10.7	11.2	5.5	12
Scranton	10.7	11.2	5.5	12
Altoona	10.7	11.2	5.5	12
Emporium	10.7	11.2	5.5	12
Indiana	10.7	11.2	5.5	12
Uniontown	10.7	11.2	5.5	12
Harrisburg	10.7	11.2	5.5	12
Williamsport	10.7	11.2	5.5	12
Dover, Del.	....	11.2	5.5	12
Wilmington, Del.	....	10.7	5.5	11.5
Boston, Mass.	....	10.9	4.5	....
Springfield, Mass.	....	11.8	4.5	....
Worcester, Mass.	....	11.5	4.5	....
Fall River, Mass.	....	11	4.5	....
Hartford, Conn.	....	11.6	4.5	....
New Haven, Conn.	....	11	4.5	....
Providence, R. I.	....	11	4.5	....
Atlantic City, N. J.	....	10.7	4.5	9.4
Camden, N. J.	....	10.7	4.5	9.4
Trenton, N. J.	....	10.7	4.5	9.4
Annapolis, Md.	....	11.05	5.5	10.2
Baltimore, Md.	....	10.45	5.5	9.2
Hagerstown, Md.	....	11.55	5.5	9.7
Richmond, Va.	....	11.25	6.5	11.7
Wilmington, N. C.	....	11.55	7.5	11.3
Brunswick, Ga.	....	10.4	7.5	*10.5
Jacksonville, Fla.	....	10.4	8.5	11.5

	Mineral Spirits T.W.†	V.M.&P. T.W.†
Philadelphia, Pa.	11	12.5
Lancaster, Pa.	12	13.5
Pittsburgh, Pa.	12.5	13.5

Fuel Oils—T.W.	1	2	3	5	
Phila., Pa.	9.5	8.7	8.7	5.46	4.46
Allentown, Pa.	10	9	9	....	....
Wilmington, Del.	9.5	8.7	8.7	....	....
Springfield, Mass.	9.6	9.1	9.1	....	....
Worcester, Mass.	9.6	9	9	....	....
Hartford, Conn.	9.4	8.7	8.7	....	....

*Does not include 1c Georgia kerosine tax.

†Mineral Spirits prices also apply to Stoddard Solvent; V.M.&P. prices also apply to Light Cleaners Naphtha.

Discounts:

Gasoline—to undivided dealers, 0.5c off dealer t.w., except Georgia & Florida dealer t.w. and undivided dealer t.w. prices are same.

Kerosine—Thru Penna. & Delaware, 2c off t.w price on t.w. deliveries of 25 gals. or more at one time.

S. O. Ohio††

***Sohio X-70 Gasoline (*Regular Grade*)**

	Consumer T.W.	**Resellers	‡S.S.	Gasoline Taxes	†Kerosine T.W.
Ohio, Statewide	12	10	13.5	5.5	9
Akron	12	9.5	12.5	5.5	9
Cincinnati	12	9.5	12.5	5.5	9
Cleveland	12	9.5	12.5	5.5	9
Columbus	12	9.5	12.5	5.5	9
Dayton	12	9.5	12.5	5.5	9
Marietta	12	9.5	12.5	5.5	9
[illegible]	12	9.5	12.5	5.5	9
Toledo	12	9.5	12.5	5.5	9
Youngstown	12	9.5	12.5	5.5	9

Aviation Gasoline—Statewide

	Consumer T.W.	Gasoline Taxes
Sohio aviation grade 65 octane, Spec. AN-VV-F-756	14.5	5.5
Esso Ethyl Aviation 73 Oct.	15.5	5.5
Esso Ethyl Aviation 80 Oct.	16.5	5.5
Esso Ethyl Aviation 87 Oct.(a)	17.5	5.5
Esso Ethyl Aviation 91 Oct.	17.5	5.5
Esso Ethyl Aviation 100 Oct.	24.5	5.5

(a) Effective Oct. 15, 1942.

	†Naphtha—T.W. Statewide	Lucas County
S. R. Solvent	13.5	13.5
D. C. Naphtha	14.5	14.25
V.M.&P. Naphtha	14.5	14.25
Varnolene	14.5	14.25
Sohio Solvent	14.5	14.25

Fuel Oils—T.W	No. 1	No. 2	No. 3	No. 4
Ohio, Statewide	8.3	8.3	7.8	....
Cleveland	10.3	10.3	9.8	7.55

*Renown (third-grade) prices are same as X-70 unless otherwise noted.

**Except authorized agents.

†Kerosine prices are ex 1c state tax. Naphtha prices are ex 1.5c federal & 4c state tax.

‡Prices at company-operated stations.

††Statewide prices are subject to exceptions other than those shown.

Discounts:

Esso aviation—on contract to hangar operators and resellers, 2c off consumer t.w.

Fuel oils—Statewide prices are for t.w. & drum deliveries of 50 gals. or more; prices for deliveries of less than 50 gals. are 0.5c higher. Cleveland Nos 1, 2, and 3 prices are for bulk deliveries of 5 to 99 gals.; 100 gals. and over are 2c less. Cleveland No. 4 price is for full compartment hose dump only.

Naphthas—to contract consumers off t.w. prices—Statewide: 300 to 999 gals., 0.5c; 1000 to 2499 gals. 0.75c; 2500 to 4999 gals., 1c; 5000 or more gals., 1.5c. Lucas County: Less than 50 gals., tank wagon price. 50 to 249 gals., 0.5c; 250 to 499 gals., 1c, 500 gals. or over, 1.5c.

S. O. Kentucky

Crown Gasoline (*Regular*)
Standard (*Third Grade*)

	†Net Crown	Dealer Standard	Gasoline Taxes	Kerosine T W
Covington, Ky.	9.5	8.5	6.5	9
Lexington, Ky.	10.5	8.5	6.5	9
Louisville, Ky.	10	9	6.5	9.5
Paducah, Ky.	9	8	6.5	8.5
Jackson, Miss.	10	9	7.5	*8.5
Vicksburg, Miss.	9.5	8.5	7.5	*8
Birmingham, Ala.	10	9	*8.5	9
Mobile, Ala.	9	7	*9.5	8.5
Montgomery, Ala.	10	9	*9.5	*9
Atlanta, Ga.	11.4	...	7.5	*10.5
Augusta, Ga.	11.4	...	7.5	*10
Macon, Ga.	11.4	...	7.5	10.5
Savannah, Ga.	10.4	...	7.5	* 9.5
Jacksonville, Fla.	10.4	...	8.5	9.5
Miami, Fla.	10.4	...	8.5	9.5
Pensacola, Fla.	9	8	*9.5	8
Tampa, Fla.	10.4	...	8.5	9.5

*Taxes: In tax column are included these city and county gasoline taxes: Mobile, 2c city; Birmingham, 1c city; Montgomery, 1c city and 1c county; Pensacola, 1c city. Georgia and Montgomery, Ala. have 1c kerosine tax, Mississippi 0.5c, not included in above prices.

†Consumer t.w. prices are same as net dealer prices.

S. O. Indiana

Red Crown (*Regular Grade*)
Blue Crown (*Third Grade*)
Dealer Prices

	Red Crown Cons. T.W.	Red Crown	Blue Crown	Gasoline Taxes	Kerosine T W
Chicago, Ill.	10.9	8.9	8.4	4.5	10.3
Decatur, Ill.	10.0	8.5	8	4.5	9.5
Joliet, Ill.	11.9	9.6	8.5	4.5	10 3

(Continued on next page)

Above prices include these inspection fees on both gasoline and kerosine unless otherwise specified per gallon:
Alabama 1/40c on gasoline, 1/2c on kerosine; Arkansas 1/20c; Florida 1/8c; Illinois 3/100c; Indiana 1/5c in lots of 25 bbls. or less, 2/25c in lots of more than 24 bbls.; Kansas 1/50c; Louisiana 1/32c; Minnesota 7/200c; Missouri 1/50c; Nebraska 3/100c; Nevada, gasoline 1/20c; North Carolina 1/4c; North Dakota 1/20c; Oklahoma 2/25c; South Carolina 1/8c; South Dakota 1/20c; Tennessee 2/5c; and Wisconsin 3/100c.
Kerosine inspection fees only: Iowa 3/50c; Michigan 1/5c per gal.

TANK WAGON PRICES

Commercial or consumer tank car, tank wagon, dealer, and service station prices for gasoline **do not include taxes;** *they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include 1.5c federal, and state taxes; also city and county taxes as indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect Jan. 4, 1943 as posted by principal marketing companies at their headquarters offices, but subject to later correction.*

S. O. Indiana (Cont'd)

Red Crown (*Regular Grade*)
Blue Crown (*Third Grade*)

	Red Crown Cons. T.W.	Dealer Prices Red Crown	Blue Crown	Gasoline Taxes	Kerosine T.W.
Peoria, Ill.	10.7	9.2	9.1	4.5	10.1
Indianapolis, Ind.	11.6	9.7	9.6	5.5	*9.8
Evansville, Ind.	11.4	9.9	7.9	5.5	*9.6
South Bend, Ind.	12	10.5	10	5.5	*10.2
Detroit, Mich.	11.4	9.9	9.4	4.5	9.6
Grand Rapids, Mich.	10.1	8.6	8.1	4.5	9.6
Saginaw, Mich.	11.4	9.9	9.4	4.5	9.6
Green Bay, Wis.	12.2	10.7	10.2	5.5	10.6
Milwaukee, Wis.	12.1	10.6	10.1	5.5	10.5
La Crosse, Wis.	11.9	10.4	9.9	5.5	10.3
Minneapolis-St. Paul	11.9	9.9	9.5	5.5	10.3
Duluth, Minn.	12.2	10.7	10.2	5.5	10.6
Mankato, Minn.	11.9	10.4	9.5	5.5	10.3
Des Moines, Ia.	11.4	9.9	9.4	4.5	*9.8
Mason City, Ia.	11.7	10.2	9.7	4.5	*10.1
St. Louis, Mo.	10.3	8.8	8.6	*4.5	9.8
Kansas City, Mo.	10.4	7.9	6.9	*4.5	9.4
St. Joseph, Mo.	9	9	8	*4.5	9.4
Fargo, N. D.	12.9	11.4	10.5	5.5	11.3
Huron, S. D.	12.3	10.8	10.3	5.5	10.7
Wichita, Kan.	9.7	8.2	6.5	4.5	8

Stanavo Aviation 73 Octane

Chicago, Ill.	15.7		4.5
Milwaukee, Wis.	15.9		5.5
Minneapolis, Minn.	15.7		5.5
St. Louis, Mo.	15.2		*4.5
Kansas City, Mo.	14.8		*4.5
Fargo, N. D.	16.7		5.5
Huron, S. D.	16.1		5.5

	Oleum Spirits	V.M.&P. Naphtha	Stanisol	*Taxes
(Prices are base prices before discounts)				
Chicago	13.5	13.8	12.8	4.5
Detroit	15.8	15	16.3	4.5
K. C., Mo.	13.3	14.3	13.8	1.5
St. Louis, Mo.	13.7	14.7	13.2	1.5
Milwaukee	14.4	15.4	14.9	5.5
Minneap'ls	14.2	15.2	13.5	5.5

Fuel Oils T.W.
Chicago

	Standard	Heater Oil
1-99 gals.		9
100-149 gals.		8
150 gals. & over		7.5

	Stanolex Fuel Oil No. 1	Stanolex Furnace Oil
1-99 gals.	8.5	8.5
100-149 gals.	7.5	7.5
150-399 gals.	7.5	7.5
400 gals. & over	7	7

	Stanolex Fuel Oil A	Stanolex Fuel Oil B
1-99 gals.	8	8
100-399 gals.	7	7
400-749 gals.	6	6
750 gals. & over	5.25	5.25

Stanolex Bunker C Fuel Oil

1-399 gals.	6.5
400-999 gals.	5.5
1000 gals. & over	4.5

Other Points	Stanolex No. 1	Stanolex Furnace Oil
Indianapolis		
1-99 gals.	....	*8.7
100 gals. & over	....	*7.7
Detroit		
1-99 gals.	....	7.8
100 gals. & over	....	6.8
Milwaukee		
1-99 gals.	....	8.7
100 gals. & over	....	7.7
Minneapolis		
1-99 gals.	....	8.5
100 gals. & over	....	7.5
St. Louis		
1-99 gals.	8.3	7.8
100 gals. & over	7.3	6.8
Kansas City		
1-99 gals.	....	7.6
100 gals. & over	....	6.6

*Taxes: In gasoline tax column are included these city taxes—Kansas City, St. Joseph, and St. Louis, 1c. Indiana kerosine and fuel oil prices are ex 4c state tax; Iowa kerosine prices are ex 3c state tax. In naphtha tax column are included 1.5c federal tax and state taxes.

S. O. Nebraska

(*Regular Grade*)

	T.W. Dealer	Gasoline Taxes	Kerosine T.W.
Omaha	11.4	8.9	6.5	9.8
McCook	10.5	9.4	6.5	9
Norfolk	11.9	10.4	6.5	10.3
North Platte	11	9.9	6.5	10
Scottsbluff	12.4	9.5	6.5	9.5

S. O. Louisiana

Esso Gasoline (*Regular Grade*)

	Consumer Tank Wagon	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
New Orleans, La.	8.75	9.25	8.5	*9
Baton Rouge, La.	8.75	9.25	8.5	*9.5
Alexandria, La.	8.75	9.25	8.5	*9.5
Lafayette, La.	9	9.5	8.5	*9
Lake Charles, La.	9	9.5	8.5	*11
Shreveport, La.	8.5	9	8.5	*8
Knoxville, Tenn.	9.5	10	8.5	12.5
Memphis, Tenn.	7.90	8.40	8.5	10.5
Chattanooga, Tenn.	10.5	11	8.5	11
Nashville, Tenn.	10.5	11	8.5	10
Bristol, Tenn.	10.95	11.45	8.5	13.1
Little Rock, Ark.	9.5	10	8	10

*Louisiana kerosine prices are ex 1c state tax.
Discounts:
Esso Gasoline—To undivided dealers, 0.5c off dealer t.w.

Humble Oil & Refining Co.

Humble Motor Fuel (*Regular Grade*)
Thriftane (*Third Grade*)

	Humble *Tank Wagon	Humble Re-tail	Thriftane *Tank Wagon	Thriftane Re-tail	Gasoline Taxes
Dallas, Tex.	6.5	9	4.5	6.5	5.5
Ft. Worth, Tex.	8.5††	10.5	7.5‡	9	5.5
Houston, Tex.	8.5	12.5	7.5	10.5	5.5
San Antonio, Tex.	8.5	12.5	7.5	10.5	5.5

	Kerosine *Tank Wagon	Kerosine Retail
Dallas, Tex.	7	11
Ft. Worth, Tex.	7	11
Houston, Tex.	8	11
San Antonio, Tex.		10

	Tank Car
73 Oct. Aviation Gasoline	
FOB Baytown, Tex.	8.5

*To all classes of dealers & consumers.
‡Less 1½c allowance to dealers only.
††Less 2c allowance to dealers only.

The Texas Co.

	Gasoline—Dealer T.W. Fire-Chief (*Regular*)	Indian (*3rd Grade*)	Gasoline Taxes
Dallas, Tex.	6.5	4.5	5.5
Ft. Worth, Tex.	6.5	6.0	5.5
Wichita Falls, Tex.	8.5	7.5	5.5
Amarillo, Tex.	8.5	7.5	5.5
Tyler, Tex.	8.5*	7.5*	5.5
El Paso, Tex.	9.5	8.5	5.5
San Angelo, Tex.	8.5	7.5	5.5
Waco, Tex.	8*	7*	5.5
Austin, Tex.	8.5	7.5	5.5
Houston, Tex.	8.5	7.5	5.5
San Antonio, Tex.	8.5	7.5	5.5
Port Arthur, Tex.	8.5	7.5	5.5

*Less 1c temporary allowance to all dealers.

Continental Oil Co.

(N.B. Prices are Continental's "structural" prices. Prices do not reflect temporary reductions made to meet local competition).

	Conoco Bronz-z-z (*Regular*) †Tank	Demand (*3rd Grade*) Wagon	Gasoline Taxes	Kerosine T.W.
Denver, Col.	11	10	5.5	11
Grand Junction, Col.	12	11	5.5	12
Pueblo, Col.	10.5	9.5	5.5	10.5
Casper, Wyo.	11.5	10.5	5.5	12
Cheyenne, Wyo.	11	10	5.5	11.5
Billings, Mont.	12.5	11.5	6.5	12.5
Butte, Mont.	13.5	12.5	6.5	13.5
Great Falls, Mont.	12.5	11.5	6.5	12.5
Helena, Mont.	13	12	6.5	13
Salt Lake City, Utah	13.5	12.5	5.5	14.5
Boise, Ida.	14.1	13.1	6.5	16.5
Twin Falls, Ida.	15.6	14.6	6.5	17
Albuquerque, N. M.	10.5	9.5	*7	10
Roswell, N. M.	10	9	*7	9.5
Santa Fe, N. M.	10.5	9.5	*7.5	10
Ft. Smith, Ark.	9.5	9.25	*7	9.5
Texarkana, Ark.	9	8	*5.5	9
Muskogee, Okla.	9.5	8.5	7	8.5
Oklahoma City, Okla.	9.5	8.5	7	8.5
Tulsa, Okla.	9.5	8.5	7	8.5

*Taxes: In gasoline tax column are included these city taxes—Albuquerque, & Roswell, 0.5c; Santa Fe, 1c. Texas 4c state tax applies within city limits of Texarkana, Ark.; Okla. 5.5c state applies within city limits of Ft. Smith, Ark.
†To consumers & dealers.

S. O. California

Standard Gasoline (*Regular Grade*)
Flight Gasoline (*Third Grade*)

	Standard Posted Net Tank Truck	Standard Posted Retail	Flight Posted Net Tank Truck	Flight Posted Retail	Gasoline Taxes
San Francisco, Cal.	10	14	9	12	4.5
Los Angeles, Cal.	9.5	13.5	8.5	11.5	4.5
Fresno, Cal.	11	15	10	13	4.5
Phoenix, Ariz.	12	16	10	13	6.5
Reno, Nev.	12	16	11	14	5.5
Portland, Ore.	10.5	14.5	9.5	12.5	6.5
Seattle, Wash.	10.5	14.5	9.5	12.5	6.5
Spokane, Wash.	12.5	16.5	11.5	14.5	6.5
Tacoma, Wash.	10.5	14.5	9.5	12.5	6.5

Std. Aviation 73

	Posted Net Tank Truck	Gasoline Taxes	Kerosine Tank Truck
San Francisco, Cal.	12.5	4.5	11.5
Los Angeles, Cal.	12	4.5	10
Fresno, Cal.	13.5	4.5	12.5
Phoenix, Ariz.	14.5	6.5	12.5
Reno, Nev.	14.5	5.5	13.5
Portland, Ore.	13	6.5	13.5
Seattle, Wash.	13	6.5	13.5
Spokane, Wash.	16	6.5	16.5
Tacoma, Wash.	13	6.5	13.5

Resale & Commercial: T.C. deliveries 0.25c per gal. off posted net tank truck.

Commercial: Retail deliveries, and/or tank truck deliveries of less than 40 gals., 4c per gal. above posted net tank truck price for Standard Aviation and Standard Gasoline, and 3c per gal. above posted net tank truck for Flight Gasoline, except single deliveries of less than 40 gals. to Marine trade only, which are billed at posted net tank truck price.

Canada

PRICES ON IMPERIAL OIL, LTD.

Per Imperial Gallon, which is 1.2 U. S. Gallons

3-Star Imperial Gasoline	(*Regular Grade*) †Gasoline T.W.	*Gasoline Taxes	†Kerosine T.W.
Hamilton, Ont.	17.5	11	18
Toronto, Ont.	17.5	11	18
Brandon, Man.	21	10	23
Winnipeg, Man.	20.5	10	22.5
Regina, Sask.	18	10	20
Saskatoon, Sask.	20.8	10	22.8
Edmonton, Alta.	18.9	10	20.9
Calgary, Alta.	16	10	18
Vancouver, B. C.	15	10	24
Montreal, Que.	17	11	17.5
St. John, N. B.	16.5	13	19
Halifax, N. S.	16.5	13	19

*Includes 3c Federal, and Provincial taxes.
†To divided & undivided dealers.

Tank Wagon Price Changes

(These changes have been made in price tables)

S. O. Ohio—Advanced t.w. prices 0.3c for Nos. 1, 2, 3 and 4 fuel oil for Statewide and Cleveland district.

Socony-Vacuum Oil Co.—Advanced t.w. prices 0.3c for kerosine and fuel oils at all points, effective Dec. 29.

TOO LATE TO CHANGE IN TABLES

Atlantic Refining Co. has advanced tank wagon prices for kerosine, Nos. 1, 2, 3, 5, and 6 fuel oils 0.3c at all points. Effective date at Annapolis, Baltimore, Hagerstown, Richmond, Wilmington (N. C.), Brunswick, Jacksonville, Springfield, Worcester and Hartford is Dec. 30. Effective at other points on Dec. 29.

Above prices include these inspection fees on both gasoline and kerosine unless otherwise specified per gallon:
Alabama 1/40c on gasoline, 1/2c on kerosine; Arkansas 1/20c; Florida 1/8c; Illinois 3/100c; Indiana 1/5c in lots of 25 bbls. or less, 2/25c in lots of more than 25 bbls.; Kansas 1/50c; Louisiana 1/32c; Minnesota 7/200c; Missouri 1/50c; Nebraska 3/100c; Nevada, gasoline 1/20c; North Carolina 1/4c; North Dakota 1/20c; Oklahoma 2/25c; South Carolina 1/8c; South Dakota 1/20c; Tennessee 2/5c; and Wisconsin 3/100c.
Kerosine inspection fees only: Iowa 3/50c; Michigan 1/5c per gal.

CRUDE OIL PRICES

Prices in $ per bbl. of 42. U. S. gals. at the well. A. P. I. gravity. Prices are effective as of 7 a. m. of dates shown.

EASTERN & CENTRAL STATES FIELDS

PENNSYLVANIA GRADE

Posted by Jos. Seep Purch. Agency (Mar. 26, '42)

Bradford-Allegany $3.00
Southwest Penna. $2.65
Eureka (West Va.) $2.59
Corning, O. (May 27, '41) $1.31

Posted by The Pennzoil Co. (Mar. 26, '41)

National Transit $2.93*

Posted by Valvoline Pipe Lines (Mar. 26, '42)

Bradford (Elk & McKean Counties, Pa.) $3.00
Warren, Forest, Venango, Clarion & Butler Counties, Pa. $2.93
Alleghany, Beaver, Washington & Greene Counties, Pa. $2.65
West Virginia $2.59
Southeastern Ohio $2.55

*Applies to Cochran, Franklin, Hamilton & Doolittle districts; prices in other lower districts range down to $2.88 per bbl. at well.

MICHIGAN

Posted by Pure Oil Co. (May 27, '41)

Midland, Midland County $1.44
Sherman $1.39

Posted by Simrall Corp. May 27, '41

Greendale, Porter, Vernon, Crystal & Wise $1.44
Buckeye, Bentley, Edenville, Beaverton & Monitor (sweet crude type) $1.42
Freeman, Redding, Lincoln & Winterfield $1.39
West Branch-Arenac $1.24
Hamilton-Grout $1.29

Sept. 1, '42

Fork Twps.-Mecosta Co. $1.39

Posted by Sohio Corp. (Mich. Div.)

Traverse crude in Allegan, Kent, Ottawa & Van Buren Cos. (June 2, '41) $1.45
Trenton crude, Monroe Co. (June 2, '41) $1.39

Posted by Bay Pipe Line Corp. (May 27, '41)

Saginaw & Wise $1.44
Buckeye, Bentley & Kawkawlin $1.42
Clare $1.11
Adams (June 1, '41) $1.27

ILLINOIS-INDIANA-KENTUCKY-OHIO

Posted by Sohio Corp. (May 21, '41)

Illinois Basin*, including Griffin pool $1.37
Carmi, Storms, Ill. area $1.32
Birk City, Ky. area $1.32
Corydon, Ky. area, Henderson $1.32

Posted by Ohio Oil Co. (May 21, '41)

Illinois Basin $1.37
Eastern Ill. & Western Ind. $1.22

Posted by Carter Oil Co. (May 21, '41)

Loudon, Fayette Co. Ill. $1.37

Posted by Mohawk Oil Lines, Inc. (May 21, '41)

Southern Illinois $1.37

Posted by Ashland Oil & Transp. Co.

Somerset oil in Ash. Lines, Ky.: (June 19, '41)
Big Sandy River $1.38
Kentucky River $1.43

Posted by Owensboro-Ashland Co.

Owensboro, Ky. area (May 21, '41) $1.32

Posted by S. O. Ohio (Sept. 1, '41)

Lima, Ohio $1.50
Cleveland, Lodi & Chatham (O.) areas $1.30

*Also posted by The Texas Co.

MID-CONTINENT

OKLAHOMA-KANSAS-NORTH TEXAS

(See below for companies posting and dates)

Gravity	Schedule No. 1	Schedule No. 2	Schedule No. 3
Below 21	$0.85	$0.75	$0.81
21-21.9	.87	.78	.83
22-22.9	.89	.81	.85
23-23.9	.91	.84	.87
24-24.9	.93	.87	.89
25-25.9	.95	.90	.91
26-26.9	.97	.93	.93
27-27.9	.99	.96	.95
28-28.9	1.01	.99	.97
29-29.9	1.03	1.02	.99
30-30.9	1.05	1.05	1.01
31-31.9	1.07	1.07	1.03
32-32.9	1.09	1.09	1.05
33-33.9	1.11	1.11	1.07
34-34.9	1.13	1.13	1.09
35-35.9	1.15	1.15	1.11
36-36.9	1.17	1.17	1.13
37-37.9	1.19	1.19	1.15
38-38.9	1.21	1.21	1.17
39-39.9	1.23	1.23	1.19
40 & above	1.25	1.25	1.21

Above schedules posted by:

No. 1: **S. O. Indiana** May 20, '41 in Okla. & Kans. **Sinclair-Prairie** May 20, '41 in Okla. & Kans. beginning with 25-25.9. **Continental** May 19, '41 in Okla. & Kans. beginning with Below 29 at $1.01. **Texaco** May 19, in Okla. & Kans. beginning with 28-28.9.

No. 2: **Carter** Nov. 1, '42 in Okla. & Kans., **Shell** Dec. 5, '41 in Okla. & Kans. **Magnolia** May 21, '41 in Okla.

No. 3: All Dec. 11, '41: **Stanolind & Continental** in N. Tex. **Sinclair-Prairie** in N. Central Tex. **Magnolia & Texaco** in N. & N. Central Tex. **Continental, Magnolia & Sinclair-Prairie** schedules begin with Below 29 at $0.97. **Texaco** schedule begins with 28-28.9.

TEXAS & NEW MEXICO FIELDS

Posted by Humble Oil & Refining Co.

(May 21, '41, except Panhandle, Tex. July 9, '41 and W. Central Texas Dec. 11, '41)

Gravity	Refugio	Texas Gulf Coast	Miran-do	Ana-huac	Dick-inson	East Central Texas	West Central Texas	Pan-handle, Texas	W. Texas & New Mex.	Hawkins Texas
Below 20	$1.08	$1.06	$1.03	$0.98	$0.93	....	....	$0.73	$0.70	$0.80
20-20.9	1.10	1.08	1.05	1.00	.95	....	....	.75	.72	.82
21-21.9	1.12	1.10	1.07	1.02	.97	....	....	.77	.74	.84
22-22.9	1.14	1.12	1.09	1.04	.99	....	....	.79	.76	.86
23-23.9	1.16	1.14	1.11	1.06	1.01	....	....	.81	.78	.88
24-24.9	1.18	1.16	1.13	1.08	1.03	....	....	.83	.80	.90
25 & above	....	....	....	....	....	....	....	....	....	.92
25-25.9	1.20	1.18	1.15	1.10	1.05	$0.97	$0.91	.85	.82	....
26-26.9	1.22	1.20	1.17	1.12	1.07	.99	.93	.87	.84	....
27-27.9	1.24	1.22	1.19	1.14	1.09	1.01	.95	.89	.86	....
28-28.9	1.26	1.24	1.21	1.16	1.11	1.03	.97	.91	.88	....
29-29.9	1.28	1.26	1.23	1.18	1.13	1.05	.99	.93	.90	....
30-30.9	1.30	1.28	1.25	1.20	1.15	1.07	1.01	.95	.92	....
31-31.9	1.32	1.30	1.27	1.22	1.17	1.09	1.03	.97	.94	....
32-32.9	1.34	1.32	1.29	1.24	1.19	1.11	1.05	.99	.96	....
33-33.9	1.36	1.34	1.31	1.26	1.21	1.13	1.07	1.01	.98	....
34-34.9	1.38	1.36	1.33	1.28	1.23	1.15	1.09	1.03	1.00	....
35-35.9	1.40	1.38	1.35	1.30	1.25	1.17	1.11	1.05	1.02	....
36-36.9	1.42	1.40	1.37	1.32	1.27	1.19	1.13	1.07	1.04	....
37-37.9	1.44	1.42	1.39	1.34	1.29	1.21	1.15	1.09	1.06	....
38-38.9	1.46	1.44	1.41	1.36	1.31	1.23	1.17	1.11	1.08	....
39-39.9	1.48	1.46	1.43	1.38	1.33	1.25	1.19	1.13	1.10	....
40 & above	1.50	1.48	1.45	1.40	1.35	1.27	1.21	1.15	1.12	....

Refugio: Includes crude purchased in East White Point, Greta, Melon Creek, O'Connor-McFaddin, Plymouth, Saxet, Taft, & Tom O'Connor fields.

Texas Gulf Coast: Includes crude purchased in Amelia, Clear Lake, Goose Creek, Hastings, Magnet, Mykawa, Mykawa New, Raccoon Bend, South Thompsons, Sugarland, Thompsons, & Webster fields.

Mirando: Includes crude purchased in Blanchard, Bridwell, Colorado, Comitas, Eagle Hill, Escobas, Fitzsimmons, Glen, Government Wells (North & South), Heyser, Hoffman, Kelsey, Kohler, Loma Novia, Lundell, Manilla, Mirando Valley, Placedo, Randado, Sarnosa, & Tesoro fields.

Anahuac: Includes crude purchased in Anahuac, Angleton, Cedar Point, Fisher Reef, Hull, (Old & New), Pierce Junction, Red Fish Reef, & Turtle Bay fields.

Dickinson: Includes crude purchased in Dickinson, Gillock, Hardin, League City, & Rowan fields.

East Central Texas: Includes crude purchased in Anderson, Cherokee, Limestone, & Navarro Counties, and Navarro Crossing field.

West Central Texas: Includes crude purchased in Brown, Callahan, Comanche, Eastland, Fisher, Haskell, Jones, Shackelford, Stephens, & Throckmorton Counties.

Panhandle, Texas: Includes crude purchased in Carson, Gray Hutchinson & Wheeler Counties.

West Texas & New Mexico: Includes crude purchased in Andrews, Crane, Crockett, Ector, Gaines, Glasscock, Howard Reagan, Upton, Winkler, & Yoakum Counties, Texas; Lea County, M. N.

Hawkins: Includes crude purchased in Hawkins Field, Wood County, Texas.

Conroe $1.43
Tomball 1.40
Van 1.08
Talco 0.79
East Texas & Flag Lake $1.25
Flour Bluff, E. Flour Bluff 1.33
Salt Flat, N. Salt Flat 1.14
Darst Creek, Hilbig, Carroll 1.14
Clark, Zoboroski $1.14
Alice, Benavides (N. Sweden), Sun 1.35
Ben Bolt, Clark-Muil, Tom Graham 1.35
Yates (Pecos) 0.95
La Rosa 1.33

MAGNOLIA PETROLEUM CO.

(May 21, '41)

Panhandle, Tex.—(July 9, '41)—Same as Humble except Magnolia begins with below 29 at $0.91.

West Texas—In Crane, Upton, Howard, Glasscock, Mitchell, Winkler, Cochran, Hockley, Yoakum & Gaines Cos., and in Pecos & Andrews Cos. beginning Apr. 1, '42—Same as Humble except Magnolia begins with Below 25 at $0.80.

N. Mexico—In Lea Co.—Same as Humble except Magnolia begins with Below 25 at $0.80 & ends with 36 & above at $1.04.

Cass & Panola Cos., Tex.—Below 25 at $0.88, plus 2c per degree of gravity to 40 & above at $1.20.

Mirando, Tex.—Same as Humble.

East Texas $1.25
Darst Creek 1.14
Luling 1.05
Talco ..... .79
Lytton Springs $1.17
Cleveland-Liberty Co. 1.26
Tomball 1.40

SINCLAIR-PRAIRIE OIL MARKETING CO.

West Texas & New Mexico—(May 30, '41)—Same as Humble except Sinclair-Prairie begins with Below 25 at $0.80.

Texas Gulf Coast—(May 21, '41)—Same as Humble.

Mexia District, Texas—(May 30, '41)—Same as Humble, East Central Texas, except Sinclair-Prairie also posts Below 25 at $0.95.

East Texas—(May 21, '41) $1.25

Long Lake, Texas—(May 21, '41) $1.23

Chapel Hill (Washington Co.) Tex.:
Below 50 grav. (Jan 20, '42) $1.18
50 grav. & above (Feb. 2, '42) $1.25

Mirando, Tex.—(July 1, '41)—Same as Humble.

Wade City & Clara Driscoll, Tex.—(July 1, '41)—Same as Humble Refugio.

Alfred & Magnolia City, Tex.—(May 21, '41), $1.35

STANOLIND OIL PURCHASING CO.

(May 21, '41)

Clinton, Tex.—Same as Humble Tex. Gulf Coast except Stanolind begins with Below 21 at $1.08.

Fairbanks, N. Houston & Rosslyn, Tex.—Same as Humble Dickinson schedule.

Lake Creek, Tex.—(Apr. 9, '42)—Same as Humble Tex. Gulf Coast except Stanolind begins with Below 21 at $1.08.

E. Texas ..... $1.25 **Satsuma & Tomball, Tex.** $1.40

Eureka Heights (Harris Co.)—Aug. 1, '42 ..... $1.15

W. Beaumont (Mar. 1, '42)—Same as Humble Tex. Gulf Coast.

Trinity (Kittrell) Field (Oct. 1, '42)—Same as Humble Tex. Gulf Coast.

Dyersdale Field (Nov. 1, '42)—Same as Humble Tex. Gulf Coast.

STANOLIND OIL & GAS CO.

(May 21, '41)

Spindletop (Jefferson Co., Tex.) **& Highland Island** (Galveston Co., Tex.)—Same as Humble Tex. Gulf Coast.

Hendrick & Henderson (Winkler Co., Tex.)—Same as Humble West Texas except Stanolind begins with Below 26 at $0.82.

Jay Welder (Calhoun Co., Tex.)—Nov. 14, '41—Same as Humble Anahuac.

Spencer & Pyote (Ward Co., Tex.)—June 8, '42—Same as Humble W. Texas.

Magnolia Sealey South (Ward Co., Tex.)—June 3, '42—Same as Humble W. Texas except Stanolind ends with 36 & above at $1.04.

THE TEXAS CO.

(May 21, '41)

Panhandle, Tex.—Same as Humble except Texaco begins with 34-34.9 at $1.03.

W. Texas & Lea Co., N. M.—Same as Humble except Texaco posts $0.78 for 23.9 & below and ends with 36 & above at $1.04.

Texas Gulf Coast—Same as Humble except Texaco ends with 34 & above at $1.36.

Duval, Mirando, Tex.—Same as Humble Mirando except Texaco ends with 28-28.9 at $1.21.

Refugio, Tex.—Same as Humble except Texaco ends with 28-28.9 at $1.26.

East Texas $1.25
Darst Creek, Tex. $1.14
Conroe, Tex. $1.43
Hockley & Cochran Cos., Tex .. .87

SHELL OIL CO., INC.

(May 20, '41)

West Texas & Lea Co., N. M.—Same as Humble except Shell ends with 36 & above at $1.04. Also includes Ward Co., Tex.

Fisher Co., Tex.—(Dec. 11, '41)—Same as Humble W. Central Texas except Shell begins with Below 25 at $0.89.

East Texas $1.25
Livingston field, Polk Co., Tex. $1.25
Pecos Co., Texas, (except Yates Shallow Pool) .. .95
Pecos Co., Tex., Yates Shallow Pool ..... .82
Mercy field, San Jacinto Co., Tex. (Feb. 27, '42). 1.25

CONTINENTAL OIL CO.

Carson & Hutchinson Cos., Tex.—(July 9, '41)—Same as Humble Panhandle except Continental begins with Below 29 at $0.91.

Eddy Co., N.M.—(May 30, '41)—Same as Humble N. M. schedule except Continental begins with Below 29 at $0.88.

PAN AMERICAN PRODUCTION CO.

(May 21, '41)

Hastings & S. Houston, Tex.—Same as Humble Tex. Gulf Coast except Pan Am. begins with Below 21 at $1.08.

Gillock, Tex.—Same as Humble Dickinson except Pan Am. begins with Below 21 at $0.95.

East Texas $1.25
Cayuga, Tex. ..... .90
Goodrich, Tex. (Dec. 1, '41) 1.20

CRUDE OIL PRICES

Prices in $ per bbl. of 42 U. S. gals. at the well. A. P. I. gravity. Prices are effective as of 7 a. m. of dates shown.

CALIFORNIA

Posted by S. O. California, May 23, 1941

All gravities above those quoted take highest price offered in that field)

Gravity	Signal Hill (Long Beach)	Wilmington	El Segundo	Seal Beach	Huntington Beach	Inglewood	Olinda Brea Canon	Athens-Rosecrans	Torrance	Richfield	Whittier East Coyote (La Habra)	Montebello	West Coyote Hills	Santa Fe Springs	Greeley, Canal, Wasco	Coles Levee	Mountain View	Elk Hills, Buena Vista Hills Midway-Sunset, Lakeview Area	Lost Hills	Coalinga	Gravity
14-14.9..	....	$0.68	....	....	$0.71	....	$0.70	....	$0.70	$0.70	$0.70	$0.72	....	....	....	....	....	$0.73	$0.73	$0.73	..14-14.9
15-15.9..	....	.71	....	....	.75	$0.76	.72	....	.72	.71	.72	.72	....	....	....	....	....	.73	.73	.73	..15-15.9
16-16.9..	....	.74	$0.79	....	.79	.79	.75	....	.74	.73	.75	.72	....	....	....	....	....	.73	.75	.73	..16-16.9
17-17.9..	....	.78	.82	....	.82	.82	.78	....	.77	.76	.78	.72	....	....	....	....	....	.75	.78	.73	..17-17.9
18-18.9..	$0.80	.82	.86	....	.86	.85	.81	....	.80	.79	.82	.74	....	....	....	....	....	.78	.81	.73	..18-18.9
19-19.9..	.84	.86	.90	....	.89	.88	.85	....	.83	.82	.85	.77	....	....	....	....	$0.73	.81	.84	.75	..19-19.9
20-20.9..	.88	.90	.94	....	.93	.92	.88	....	.86	.85	.89	.80	....	....	....	....	.76	.85	.87	.77	..20-20.9
21-21.9..	.92	.94	.98	....	.96	.95	.91	....	.89	.89	.92	.84	....	....	....	....	.79	.90	.90	.80	..21-21.9
22-22.9..	.96	.98	1.02	$0.88	.99	.98	.95	....	.93	.93	.96	.87	....	....	....	....	.83	.94	.93	.83	..22-22.9
23-23.9..	1.00	1.02	1.05	.92	1.02	1.01	.98	....	.97	.98	1.00	.91	....	....	....	....	.87	.99	.96	.86	..23-23.9
24-24.9..	1.03	1.06	1.07	.97	1.05	1.04	1.01	....	1.01	1.02	1.03	.94	$0.99	....	....	....	.90	1.03	.99	.89	..24-24.9
25-25.9..	1.07	1.09	1.10	1.01	1.08	1.07	1.04	....	1.05	1.06	1.07	.98	1.02	....	....	....	.94	1.07	1.01	.92	..25-25.9
26-26.9..	1.11	1.12	1.12	1.06	1.11	1.10	1.08	....	1.09	1.10	1.11	1.01	1.06	....	....	....	.97	1.11	1.04	.95	..26-26.9
27-27.9..	1.15	1.15	1.15	1.10	1.14	1.14	1.11	....	1.13	....	1.15	1.05	1.10	$1.04	....	....	1.01	1.15	1.07	.98	..27-27.9
28-28.9..	1.18	1.18	1.17	1.15	1.17	1.17	1.14	....	1.17	....	....	1.08	1.13	1.08	....	....	1.04	1.19	1.10	1.00	..28-28.9
29-29.9..	1.20	1.21	....	1.19	1.20	1.20	....	$1.17	....	....	....	1.12	1.17	1.12	....	....	1.07	1.24	1.13	1.02	..29-29.9
30-30.9..	1.23	1.24	....	....	1.23	1.22	....	1.21	....	Elwood	....	1.15	1.21	1.15	$1.01	$1.09	1.10	1.28	1.16	1.04	..30-30.9
31-31.9..	....	....	....	....	....	1.24	....	1.25	....	Terrace	....	1.19	1.24	1.19	1.04	1.12	1.14	....	....	1.06	..31-31.9
32-32.9..	....	....	....	....	....	....	....	1.29	....	F.o.b. Ship	....	1.23	1.28	1.23	1.07	1.14	1.17	....	....	1.09	..32-32.9
33-33.9..	....	....	....	....	....	....	....	1.32	....	$1.22	....	1.27	....	1.26	1.10	1.17	....	....	....	1.11	..33-33.9
34-34.9..	Kettleman Hills			....	....	....	....	1.36	....	1.25	....	1.31	....	1.30	1.13	1.20	....	....	....	1.13	..34-34.9
35-35.9..	....	$1.23	....	....	....	....	....	....	....	1.28	....	1.35	....	....	1.16	1.22	....	....	....	....	..35-35.9
36-36.9..	....	1.26	....	....	....	....	....	....	....	....	....	1.39	....	....	1.19	1.25	....	....	....	....	..36-36.9
37-37.9..	....	1.29	....	....	....	....	....	....	....	....	....	1.43	....	....	1.22	....	....	....	....	....	..37-37.9
38-38.9..	....	....	....	....	....	....	....	....	....	....	....	1.47	....	....	1.25	....	....	....	....	....	..38-38.9
39-39.9..	....	....	....	....	....	....	....	....	....	....	....	1.51	....	....	....	....	....	....	....	....	..39-39.9
40-40.9..	....	....	....	....	....	....	....	....	....	....	....	1.53	....	....	....	....	....	....	....	....	..40-40.9

Playa Del Rey: (FOB Standard Pipe Line) 20-20.9, $0.80; 21-21.9, $0.84; 22-22.9, $0.87.
Wheeler Ridge: 22-22.9, $0.76; 23-23.9, $0.80; 24-24.9, $0.83.
Newhall, Kern River, Kern Front, McKittrick & Round Mountain: 14-14.9, $0.73.

LOUISIANA-ARKANSAS

Posted by S. O. Louisiana, May 22, '41

Gravity	Atlanta, Ark et al.	De Soto, La. et al.	Rodessa, La. et al.	Bunkie, La. et al.	Darrow, La. et al.	University, La.* (Baton Rouge) Shallow Production
40 & Above..	$1.08	$1.18	$1.20	$1.30	$1.30	$1.48
39-39.9.....	1.06	1.16	1.18	1.28	1.28	1.46
38-38.9.....	1.04	1.14	1.16	1.26	1.26	1.44
37-37.9.....	1.02	1.12	1.14	1.24	1.24	1.42
36-36.9.....	1.00	1.10	1.12	1.22	1.22	1.40
35-35.9.....	.98	1.08	1.10	1.20	1.20	1.38
34-34.9.....	.96	1.06	1.08	1.18	1.18	1.36
33-33.9.....	.94	1.04	1.06	1.16	1.16	1.34
32-32.9.....	.92	1.02	1.04	1.14	1.14	1.32
31-31.9.....	.90	1.00	1.02	1.12	1.12	1.30
30-30.9.....	.88	.98	1.00	1.10	1.10	1.28
29-29.9.....	.86	.96	.98	1.08	1.08	1.26
28-28.9.....	.84	.94	.96	1.06	1.06	1.24
27-27.9.....	.82	.92	.94	1.04	1.04	1.22
26-26.9.....	.80	.90	.92	1.02	1.02	1.20
25-25.9.....	.78	.88	.90	1.00	1.00	1.18
Below 25....	....	.86	.88	.98	....	....
24-24.9.....	.76	....	.88	....	.98	1.16
23-23.9.....	.74	....	.86	....	.96	1.14
22-22.9.....	.72	....	.84	....	.94	1.12
21-21.9.....	.70	....	.82	....	.92	1.10
Below 21....	.68	....	.80	....	.90	....
20-20.9.....	....	....	....	....	....	1.08
Below 20....	....	....	....	....	....	1.06

*Posted July 2, '42.

Atlanta schedule includes Buckner, Lewisville, Magnolia, Village & Schuler (Jones Sand), Ark.

De Soto schedule includes Sabine, Fouke, Homer, Miller co., Nebo & Sugar Creek, Lake St. John (4500 ft. prod.) Sept. 5, '42

Rodessa schedule includes Cotton Valley & Shreveport (Cross Lake) ending with Below 25 at $0.88; Anse La Butte (Aug 1, '41); Caddo (Oct. 15, 1941).

Bunkie schedule includes Eola, Olla, South Olla, Pine Prairie (May 21, '42), and University (Baton Rouge) Deep Production (May 22, '42).

Darrow schedule includes Bayou Mallet, Choctaw, Jeanerette, Lirette, N. & S. Crowley, Port Allen, Port Barre, Potash, Roanoke, & St. Martinville.

University schedule includes Hackberry (posted by Stanolind Oil & Gas, May 21, '41 ending with 34 & above at $1.36).

Big Creek, McKamie, Distillates (Sour).... $1.15
Heavy Smackover Crude..... .83
Cotton Valley Distillate (Sept. 1, '41)..... 1.40
Cotton Valley (Holloway Sand Crude)..... 1.25
Lisbon Distillate..... 1.20
Dorcheat, Macedonia Distillates (Nov. 16, '42) 1.30

(*Continued next column*)

LOUISIANA-ARKANSAS (*Cont'd*)

Posted by Shell Oil Co., Inc. (May 20, '41)

	Iowa	Roanoke	Gibson
Below 20.....	$0.99	$0.94	$0.89
20-20.9.....	1.01	.96	.91
21-21.9.....	1.03	.98	.93
22-22.9.....	1.05	1.00	.95
23-23.9.....	1.07	1.02	.97
24-24.9.....	1.09	1.04	.99
25-25.9.....	1.11	1.06	1.01
26-26.9.....	1.13	1.08	1.03
27-27.9.....	1.15	1.10	1.05
28-28.9.....	1.17	1.12	1.07
29-29.9.....	1.19	1.14	1.09
30-30.9.....	1.21	1.16	1.11
31-31.9.....	1.23	1.18	1.13
32-32.9.....	1.25	1.20	1.15
33-33.9.....	1.27	1.22	1.17
34 & above.....	1.29	1.24	1.19

Iowa schedule includes Black Bayou & White Castle La. fields.

Roanoke schedule includes Chalkley, La. field.

Gibson schedule includes S. Houma, Hester & W. Lake Verret, La. fields.

Happytown field, St. Martin Par., La..... $1.15

Posted by Arkansas Fuel Oil Corp.
Urania, La. (May 22, '41)..... $1.15

Posted by Continental Oil Co. (May 21, '41)
Tepetate, La..... $1.18
Ville Platte, La..... 1.20
Lake Arthur, La..... 1.18

Abbeville, La.

Below 36..$1.07	37-37.9..$1.11	39-39.9..$1.15
36-36.9.. 1.09	38-38.9.. 1.13	40 & above 1.17

Acadia Parish (Evangeline), La.

Below 32..$1.07	34-34.9..$1.13	37-37.9..$1.19
32-32.9.. 1.09	35-35.9.. 1.15	38-38.9.. 1.21
33-33.9.. 1.11	36-36.9.. 1.17	39-39.9.. 1.23
		40 & above 1.25

CANADIAN FIELDS

Posted by Imperial Oil Limited
Western Ontario (Nov. 6, 1939)

Petrolia.....$2.35 Oil Springs.....$2.42

Turner Valley Crude Oil (July 16, '41)
(Prices FOB producer's tankage)

33-33.9..$1.35	44-44.9..$1.57	55-55.9..$1.79
34-34.9.. 1.37	45-45.9.. 1.59	56-56.9.. 1.81
35-35.9.. 1.39	46-46.9.. 1.61	57-57.9.. 1.83
36-36.9.. 1.41	47-47.9.. 1.63	58-58.9.. 1.85
37-37.9.. 1.43	48-48.9.. 1.65	59-59.9.. 1.87
38-38.9.. 1.45	49-49.9.. 1.67	60-60.9.. 1.89
39-39.9.. 1.47	50-50.9.. 1.69	61-61.9.. 1.91
40-40.9.. 1.49	51-51.9.. 1.71	62-62.9.. 1.93
41-41.9.. 1.51	52-52.9.. 1.73	63-63.9.. 1.95
42-42.9.. 1.53	53-53.9.. 1.75	64 & over 1.97
43-43.9.. 1.55	54-54.9.. 1.77	

Absorption Gasoline (July 16, '41)
90% Rec., 20 lb Reid v.p.....$2.28
90% Rec., 17 lb. Reid v.p..... 2.44

ROCKY MOUNTAIN FIELDS

Posted by Stanolind Oil & Gas Co. (May 20, '41)

Salt Creek (except Tensleep crude), Midway & Dutton Creek, Wyo.

Below 29..$0.96	32-32.9..$1.04	36-36.9..$1.12
29-29.9.. .98	33-33.9.. 1.06	37-37.9.. 1.14
30-30.9.. 1.00	34-34.9.. 1.08	38-38.9.. 1.16
31-31.9.. 1.02	35-35.9.. 1.10	39-39.9.. 1.18
		40 & above 1.20

Wyoming:		Wyoming:	
Tensleep Crude....	$0.82	Grass Creek Light	$1.00
Frannie Light.....	.70	Grass Creek Heavy	.50
Frannie Heavy.....	.47	Elk Basin.....	1.00
Hamilton Dome....	.45	Frontier Crude...	1.00
		Hes, Colo.....	1.07

Posted by Ohio Oil Co. (May 20, '41)
Elk Basin, Wyo.....$1.00
Grass Creek Wyo., Light..... 1.00
Rock Creek, Wyo..... 1.15
Lance Creek, Wyo., (July 1, '41)..... 1.12

Posted by Continental Oil Co. (May 21, '41)
Ft. Collins & Wellington, Col.

Below 29..$0.96	32-32.9..$1.04	36-36.9..$1.12
29-29.9.. .98	33-33.9.. 1.06	37-37.9.. 1.14
30-30.9.. 1.00	34-34.9.. 1.08	38-38.9.. 1.16
31-31.9.. 1.02	35-35.9.. 1.10	39-39.9.. 1.18
		40 & above 1.20

Canon City & Florence, Col.....$1.05	Big Muddy, Wyo., (May 30, '41)...$1.08
Cat Creek, Mont.. 1.15	Lance Creek, Wyo., (July 1, '41).... 1.12

Posted by Independent Pipe Line Co. (Aug. 1, '41)
Falls City, Neb., field price..... $0.90
Falls City, Neb., loaded in tank cars..... 0.95
Shubert, Neb., loaded in tank cars..... 0.97

SOUTHEASTERN FIELDS

Posted by Allied Pipe Line Corp.

Tinsley (Miss.) Crude (Oct. 16, '41)

24-24.9.....$0.745	32-32.9.....$0.905	
25-25.9..... .765	33-33.9..... .925	
26-26.9..... .785	34-34.9..... .945	
27-27.9..... .805	35-35.9..... .965	
28-28.9..... .825	36-36.9..... .985	
29-29.9..... .845	37-37.9..... 1.005	
30-30.9..... .865	38-38.9..... 1.025	
31-31.9..... .885	39-39.9..... 1.045	
	40 & above..... 1.065	

Pickens (Miss.) Crude (Dec. 16, '41)

24-24.9.....$0.685	32-32.9.....$0.845	
25-25.9..... .705	33-33.9..... .865	
26-26.9..... .725	34-34.9..... .885	
27-27.9..... .745	35-35.9..... .905	
28-28.9..... .765	36-36.9..... .925	
29-29.9..... .785	37-37.9..... .945	
30-30.9..... .805	38-38.9..... .965	
31-31.9..... .825	39-39.9..... .985	
	40 & above..... 1.005	

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WANTED—Fuel Oil Truck, complete with meter, hose, etc. 1,000 to 1,600 gallon capacity. Only equipment in first class condition will be considered. D. M. Silkworth Oil Co., Ypsilanti, Mich.

WANTED

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Acheson Colloids Corp.
American Flange & Mfg. Co.
Armstrong Rubber Co.
Autocar 17

Badger & Sons Co., E. B. 25
Battenfeld Grease & Oil Corp.
Bayou State Oil Co.
Bechtel-McCone-Parsons Corp.
Birmingham Tank Co.
Blackmer Pump Co.
Bowser & Co., S. F.
Brodie Co. Inc., Ralph N.
Buckeye Iron & Brass Works
Butler Manufacturing Co.

Canfield Oil Co.
Champion Spark Plug Co. 21
Cities Service Oil Co.
Continental Can Co.
Crown Can Co.

Ethyl Corp. 1
Erie Meter Systems, Inc.

Farrell Mfg. Co.
Fruehauf Trailer Co.
Fleet-Wing Co.
Freedom Oil Co. 34

General American Trans. Corp.
General Motors Corp.
Gilbert & Barker Mfg. Co.
Goodrich, B. F. 31
Goodyear Tire & Rubber Co.
Gulf Oil Corp. 23

Heil Co.
Humble Oil Co.
Houdry Process Corp.

International Harvester Co.
International Metal Hose Co.

Johnston & Jennings Co.

Kidde & Co. Inc., Walter

McDonald Mfg. Co., A. Y.
Mack Trucks, Inc.
Master Electric Co.
Mid-Continent Petroleum Corp. 27
Morrison Bros.

Neptune Meter Co.

Ohio Oil Co.

Paraflow
Pharis Tire & Rubber Co.
Philadelphia Valve Co.
Pittsburgh Equitable Meter Co.
Platt's War-Oil Communication Services Inside Back Cover
Pure Oil Co.

Reeves Brothers
Republic Oil Co. 38
Revere Electric Mfg. Co.

Service Station Equipment Co.
Shell Oil Co., Inc.
Sinclair Refg. Co., Inc.
Standard Steel Works 33
Socony-Vacuum Oil Co.
Stearns & Co., E. C.
Sun Oil Co. Outside Back Cover

Texaco Development Corp.
Thiokol Corp. 29
Timken Detroit Axle Co.
Tokheim Oil Tank Co. Inside Front Cover
Truckstell, Inc.
Truktor Corp.

Union Tank Car Co.
Universal Oil Products Co.

Venango Refining Co. 18
Viking Pump Co. 37

Wayne Pump Co.
Wilson & Bennett Mfg. Co.

PERSONALS

John M. Martin

Appointment of **John M. Martin** as general manager of the eastern marketing division for Socony-Vacuum has been announced by the company. **W. L. Faust,** now a vice-president of the company, formerly managed the division, which directs sales activities in New England, New York, New Jersey, Pennsylvania, Delaware, Maryland and several southern states.

Mr. Martin started with Socony in Albany in 1904 as a junior clerk. He became district manager in the Utica division in 1917 and later rose to the position of general manager of the Albany division. He was transferred to New York as assistant to the general manager of eastern marketing in 1931 and in 1939 went to Boston as assistant manager of the New England division, later returning to the New York office.

° ° °

Mrs. Charles W. Esky is back at her desk at the Petroleum Administration for War after a honeymoon in New England. Her husband, **Lieut. Charles W. Esky,** U.S.N.R., is stationed in Washington. The wedding took place Dec. 5. Visitors to the office of E. Holly Poe, director of PAW's natural gas and natural gasoline division, will remember this red-headed girl as Miss Kathryn Sweeny.

° ° °

Ensign is the title now for **Edward B. Juliber,** who joined the Navy and is now at Princeton for a training course, according to his former associates at PAW. Most people remember Mr. Juliber for his work as chief of OPC's L-70 unit (gasoline curtailment) last summer.

° ° °

J. H. Sembower, New York, head of Shell's public relations, is now a lieutenant (j.g.) in the Navy and is training at Washington, D. C.

° ° °

Union Oil Co. of California has announced the appointment of **Wendell Thayer** as special assistant to **Reese Taylor,** president of the company.

Effective Jan. 4, Mr. Thayer will be assigned to government-labor relations duties. He has been with the Southern California office of the *Wall Street Journal* since 1935.

° ° °

Three divisions of Tide Water Associated Oil Co.—the Los Angeles general office, the Oregon sales division, and the California pipeline department—have received the Treasury Department's "T" flag for having over 90% of employes subscribe 10% or more in war bonds. **F. E. Coyle,** superintendent of the California pipeline department at Watson, received the award for his division which has a 100% record; **Harrison Guio,** attorney for the division, represented the Los Angeles general office; and **C. R. Clark,** district sales manager, accepted the award for the Oregon sales district at Portland.

° ° °

A. Clarke Bedford

A. Clarke Bedford, assistant general sales manager of New Jersey Standard since 1936, has been named general sales manager to succeed R. T. Haslam, recently elected director of Standard Oil Co. (N. J.), company has announced.

Mr. Bedford has been engaged in sales work with the company and its affiliates since 1920, when he was made a member of the marketing committee of the Jersey company. Prior to that, and following his graduation from Williams College in 1913, he was engaged in refining, accounting, and production work for the company. During World War I he served as captain in the Quartermaster Corps and spent 8 months in France. He returned to the Carter Oil Co. and was secretary and assistant treasurer before joining the Jersey company marketing committee.

In 1926 he became joint manager of domestic sales for the Jersey company and in 1927 went to New Orleans as a vice-president and director of Louisiana Standard. In 1931 he went to Boston as president of Colonial Beacon Oil Co. and in 1933 returned to New York as sales coordinator of Esso Marketers, continuing as Colonial Beacon president. Three years later, in 1935, he became assistant general sales manager.

° ° °

The Oil Men's Club of Kansas City (Missouri) held its 9th annual Christmas party Dec. 21 at the President Hotel. R. V. "Bob" Merrick, chairman, reports. The party was dedicated to raising funds to care for needy children and the aged at Christmas, and over $400 was donated. The traditional Tom and Jerry was furnished by Butler Manufacturing Co. and Columbian Steel Tank Co.

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p l u s —

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NATIONAL PETROLEUM NEWS

Monthly Technical Section Devoted to
REFINERY MANAGEMENT and PETROLEUM CHEMICAL TECHNOLOGY

Volume 35 | January 6, 1943 | Number 1

Women Must Replace Men in Refinery Jobs To Hold Products Output at Wartime Peak

Girls now work in laboratories, plant offices and act as messengers; are now being trained by some companies for light manual work.....R-4

War Model Gasoline Plants Run for High LPG Yield

Their operators are furnishing materials for products needed in the war program; are also preparing to participate in postwar markets for chemical and plastic derivatives from petroleum...R-7

Arc Welding Stainless Steel Linings in Presssure Vessels

By W. W. McClow

($3700 Prize Article in Welding Program)

How one oil company conserves steel by applying strip linings to bubble towers, fractionating towers, strippers and other equipment subject to high temperature corrosion.....R-10

The Chemical Utilization of Hydrocarbons by Oxidation

By Hooper Linford

Future potentialities outlined for refiners in this type of reaction for processing natural gas and natural gasoline fractions into chemical derivatives and other new products.....R-15

Synthetic Rubber Is Product Of 'Molecular Engineering'

By R. L. Wakeman and B. H. Weil

Second article in series "ABC of Chemical Derivatives from Petroleum" tells of major role of petroleum chemists in developing most suitable types for specific purposes, as well as methods to produce the raw materials for manufacture of synthetic rubber R-22

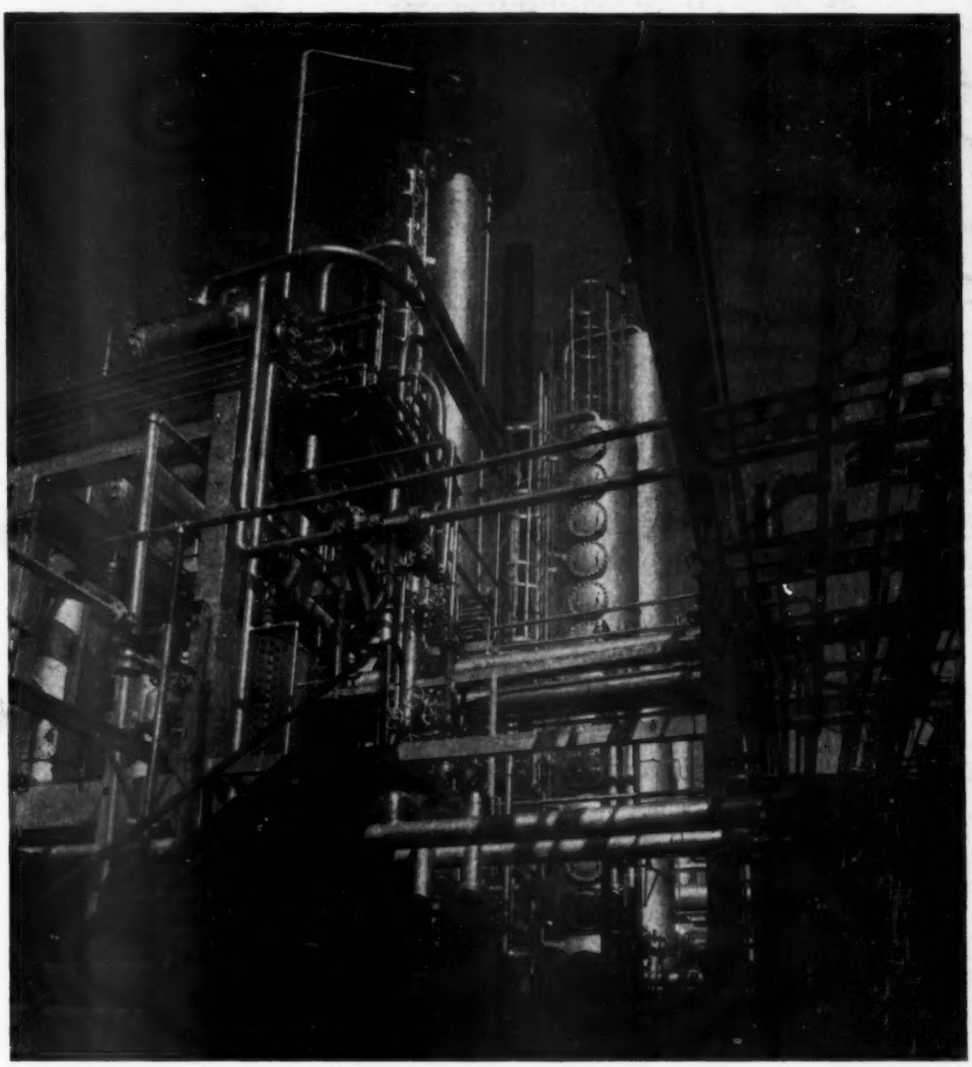
Refinery and Gasoline Plant Piping Standards Revised

New method is announced for computing pipe wall thickness which provides greater flexibility in meeting requirements of high pressure plants. Three articles describe the new features of the Oil Section of the A.S.A. Code for Pressure Piping R-32

Grease Characteristics At Low Temperature

By Thomas A. Maxwell

Severe requirements of military service bring study of the factors that determine the behavior of bearing greases R-42



CONVERTED FROM PEACETIME TO WAR PRODUCTS—This new polymerization plant at the refinery of Ashland Oil & Refining Co. has already been converted from making motor fuel to the manufacture of cumene (isopropylbenzene), an essential component of fighting grade aviation gasoline. Geared to full wartime production, the cracking plant which supplies the refinery gas which is charged to the "poly" plant recently made a record run of 103 days, which the company believes established a record for the oil industry of throughput of charging stock without a shutdown of the unit

First Oil Man to be President Of American Chemical Society

First man from the petroleum industry to be elected president of the American Chemical Society, taking office Jan. 1, is Per K. Frolich, director of the Esso Laboratories-Chemical Division of Standard Oil Development Co. At the age of 43, Dr. Frolich is also the youngest man in over 30 years to head the society which, with a membership of 32,000, is the largest professional organization of its kind in the world.

Born in Norway and receiving his early education there, he went in 1922 to Massachusetts Institute of Technology with an American-Scandinavian Foundation Fellowship. He obtained his Doctor's degree in Chemical Engineering there in 1925. He was on the staff of M.I.T. from 1922 to 1929 and was associate professor in chemical engineering when he left to join the Standard Oil Development Co., starting as a research chemist at Bayway.

Originally trained as an electro chemist, at M.I.T. Dr. Frolich first became interested in colloid chemistry and later in the study of high pressure gas reactions, which led him into the petroleum field. With Standard Oil Development Co. his activities have been principally with the development of new chemical uses for petroleum and it was therefore only natural that he should become identified with Standard's synthetic rubber program, to which he now devotes practically all his attention.

Dr. Frolich has published a number of scientific and technical papers, holds a number of patents and patent applications, and is active in various scientific societies. In 1930 he was awarded the Grasselli Medal by the (British) Society of Chemical Industry for his work on gas reactions carried out under high pressure.

Per K. Frolich

REFINERY MANAGEMENT *and* PETROLEUM CHEMICAL TECHNOLOGY

January 6, 1943
Volume 35
Number 1

A MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS *incorporating International Petroleum Technology*

Message to Oil Industry Chemists and Chemical Engineers

War Program is Stimulating the Development of Means For More Selective Processing of Hydrocarbons

FROM a technical standpoint the oil industry's war program is characterized by an effort to control hydrocarbon transformations in such a manner as to produce well defined chemical compounds or, more frequently, groups of compounds closely related in chemical structure. That petroleum technology was aiming in this direction has been evident for some time. In fact, the war program is the direct outgrowth of research which has been going on at an accelerated pace for the last decade or so. This work has been concerned chiefly with studies of the chemistry of petroleum hydrocarbons, the development of new types of catalysts, and the development of improved methods of separating hydrocarbons.

Practically everything which is being done in the processing of oil leads to changes in the chemical composition or distribution of the petroleum hydrocarbons involved. It was the growing effort to produce fuels of high octane number and generally improved engine performance, which first made the petroleum technologist appreciate the significance of these changes from the standpoint of obtaining the most desirable chemical structures. As he learned more and more about what specific type or types of chemical structures were preferred, the limitations of simple thermal cracking became increasingly apparent.

Thermal cracking as normally carried out is an extremely complex chemical operation. The feed stock to the cracking unit consists of a great variety of hydrocarbons differing widely in structure and chemical properties. We now know that under the operating conditions employed, each one of these hydrocarbons is capable of undergoing multitudinous chemical reactions, including simple molecular rupture ("primary cracking"), polymerization, recracking, repolymerization, alkylation, isomerization, dehydrogenation, aromatization, and hydrogenation. We also know that there is no combination of operating temperature, pressure, and time which is ideal for any two of these transformations to be carried out simultaneously. Straight thermal cracking is therefore bound to be a compromise to give the best possible overall chemical composition from the standpoint of fuel performance without undue sacrifice in loss to such undesirable products as coke and gas.

By the proper choice of selective catalysts it is possible to crack under conditions which generally favor the formation of hydrocarbon structures possessing high octane number as well as high lead susceptibility. The same operating conditions will also produce increasing quantities of low molecular weight hydrocarbons suitable for recombination by polymerization and alkylation into structures which are even more desirable from the standpoint of manufacturing high octane aviation fuel. The utilization of these low molecular weight fractions can be effected in a variety of ways, some of which have been reviewed in the current literature.

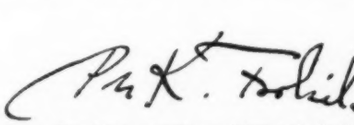
The conversion of olefins to the corresponding alcohols represented the first effort to manufacture well defined chemical compounds from individual hydrocarbons. This process dates back some 20 years. By the aid of chlorination and other manipulations a whole new field of olefin chemistry has since been built up to give a great many finished products and intermediates, some of which are of extreme importance to the present war effort. The most recent and striking developments along the lines of producing individual chemical compounds are the manufacture of toluol for explosives and the manufacture of butadiene for synthetic rubber.

Polymerization became a by-word when, less than ten years ago, the first process was developed for uniting two molecules of isobutylene as the initial step in the production of commercial iso-octane. As the other extreme, we now know how to string literally thousands of olefin and diolefin molecules into the type of polymer chains which go to make up synthetic rubber.

We do not have to limit ourselves to the developments in fuels and chemicals, for this chemical trend is quite general as far as the petroleum industry is concerned. Lubricating oils are becoming more and more of a made-to-order proposition into which goes a variety of synthetic chemical compounds, carefully designed to meet the rigorous requirements of war uses. New and improved process oils and other specialty products are rapidly being developed, and even asphalt has turned out to be quite amenable to chemical change.

It is always dangerous to make predictions. However, there can be no doubt in this instance that the course is set for future developments in petroleum technology. While there may be changes in relative emphasis, the general trend is, and will be increasingly so, toward processing petroleum hydrocarbons in terms of more clearly defined chemical reactions. The work which has been done so far covers only some of the possibilities in this direction. On the one hand, there are the high boiling and more complex hydrocarbons which still present many unsolved problems. On the other hand, we have the lowest boiling hydrocarbons, particularly methane, whose efficient utilization still continues to challenge the petroleum technologist.

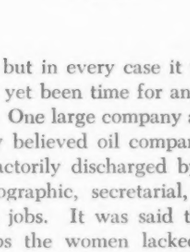
In attempting to judge what has been accomplished to date, we must keep in mind that the chemistry of aliphatic hydrocarbons is being completely rewritten these days. Slowly but gradually, our colleges and universities are placing emphasis on this special branch of organic chemistry, and as new generations of chemists and chemical engineers are being trained, we may confidently look forward to chemical developments which will make those we are witnessing today appear a mere beginning of a new era in petroleum technology.



President, American Chemical Society

Women Take Over Men's Plant Jobs

Wartime Manpower Shortage Puts Girls in Jobs at Laboratories, Plant Offices and as Messengers; Coming Months Will Find Them Doing Manual Work in Refineries and Gasoline Plants



TURN that old copy book motto "Woman's Place is in the Home" to the wall for the duration anyhow.

For the war manpower shortage is already causing the replacement of men workers by women in some jobs in refineries, natural gasoline plants and production departments. Authorities close to the general employment situation say they also will have to be used by many oil companies for light manual work if their plants are to maintain top production levels in coming months.

In most cases the women so far are filling jobs in laboratories and plant offices where formerly men worked. A few refiners, however, are using women as plant messengers. for picking up meter charts from leases, as helpers on loading racks and also in a wider variety of jobs in candlemaking and canning departments than women heretofore have been used.

Of many other refining companies canvassed, at least half are now conducting plant surveys to see where women can fill men's jobs and also are trying to locate sources from which they can secure women workers. A few companies said they would continue to hire men as long as they were available before turning to women for any jobs. About 10% of companies interviewed said flatly a refinery or gasoline plant is no place for a woman and if forced to depend on them for labor replacements they would sooner close down their plants.

Approximately 15% of the research staff (excluding stenographers and secretaries) of Phillips Petroleum Co. at Bartlesville, Okla., now are women and the proportion will increase rapidly, the company says. Of these women one has acquired a doctor's degree, specializing in chemistry, 4 have master's degrees, 13 have bachelor's degrees, 5 have had two years or more of college training, 2 have business college training and 2 are high school graduates. One woman is a chemical engineer, 16 are chemists and 4 others have had some training in chemistry and other sciences. Their ages run from 18 to 44.

The majority are employed in the analytical section of the research department, which conducts chemical and physical tests on samples submitted by other sections of the department, and is a training ground for laboratory workers. In other sections, 3 are in gas conversion, 2 in development in refining, 2 in service, 2 in core research. The work of the staff women is described by the company as "highly satisfactory".

A statement on the subject of "womanpower" has been issued to all employes by Frank Phillips, chairman of Phillips Petroleum Co. "Authorities who are in a position to know the facts declared that American industry must employ at least 3 million women during the next 12 months," he stated. "A careful analysis of our own company indicates that present operations cannot be maintained and vital new facilities cannot be completed or operated without assistance from 'womanpower'. Phillips Petroleum Co. will need hundreds of women in manual jobs. Several dozen already are taking special training or are performing manual operations for which men could no longer be obtained.

"I realize that there are problems which must be solved to effectively and efficiently fit large numbers of women employes into our organization," he said. "But certainly this can be done in view of emergency war conditions that now exist."

He asked all employes to be tolerant and helpful in the task of adjusting the company's operations so women could be used in places formerly filled by men. Mr. Phillips said that in many sections of the country acute shortages of promising women applicants for plant jobs already have developed and that further delay in accepting them into the company's service would not only hamper its war operations, but might make it impossible to obtain the kind of women employes its operations required.

Another oil company, which for some years has been using a definite proportion of women as laboratory helpers and chemists, is hiring women for all replacements as rapidly as those with proper qualifications can be found. Their work is reported satisfactory, with no kicks from either the men or women already on the staff. Other companies reported using from one up to 20 women now in places formerly filled by men.

Another oil company is already replacing men with women for light work on leases, such as servicing recording meters; as loaders and helpers on naphtha and gasoline loading racks as well as laboratory assistants. Five women are now thus employed. The company expects to hire more women for these same tasks as men are called into service and also to use them as boiler firemen where automatic stokers are used, and as oilers and wipers in its refinery and gasoline plant.

Among the oil companies which are already using women in jobs that men used to fill, there is a difference of opinion as to how they are working out, but in every case it was admitted there has not yet been time for any conclusions to be drawn. One large company and one small one said they believed oil company work cannot be satisfactorily discharged by women except in stenographic, secretarial, clerical and similar office jobs. It was said that for plant operating jobs the women lacked mechanical adaptability, failed to exercise independent judgment where it was called for, in some cases were "gripers" and that petty jealousies developed among women to a greater extent than among men.

Other companies believe women can fill many plant jobs as well as men particularly if duties are of a routine nature. They think the women will have better safety records than the men in the same jobs, because they are more inclined to follow instructions to the letter. One company said it would keep women for its refinery clerical force and for messengers after the war, and when the men that had filled these jobs came back, they would be used in other places in the plant.

General considerations in hiring women for plant work are that they should not be used for night work, especially in the "graveyard" shift, because of the responsibility on the management to see that they are properly protected to and from work, as well as in the plant. Another general problem is in the hiring of the proper type of woman, both to keep them contented and to maintain harmony in the plant crews.

Where Women May Be Used

Many companies are giving much study to where women may be used in refineries, gasoline plants, pipeline and production departments during the coming months when the manpower shortage threatens to become even more acute. Following is a list of the kinds of work for which women are being considered:

- Clerical help
- Messengers, and mail delivery
- Chemists, laboratory helpers
- Oilers
- Boiler firemen
- Tank car checkers
- Pipeline walkers
- Stillman helpers
- Janitors
- Instrument repair and maintenance
- Truck drivers, for light work
- Electricians
- Painting and carpenter shop work (light and at low levels)
- Warehouse and shipping departments
- Yard cleanup
- Sample jerkers
- Reclamation department (light work)
- Pipeline dispatchers
- On loading racks
- For light machine work
- Light welding, pipefitting
- Telegraph and telephone operators
- Gateman
- Pipeline dispatchers, gaugers
- For light operating jobs
- Draftsmen

One natural gasoline manufacturer states women can be used "most anywhere" in the ordinary casinghead plant except in heavy main-

Girl Research Chemists and Helpers on Phillips Petroleum Co. Staff

Shown in the picture are 21 of the 27 women who thus far have taken the place of men on the research staff of Phillips Petroleum Co. at Bartlesville, Okla., who have joined the nation's armed forces. Eighteen of the 27 have college degrees, most of them from schools in the southwest, a few from the state universities in the middle west

tenance and construction work. Among suggested classifications were: all clerical and timekeeping work, material and transfer department including taking inventory in plant and field, warehouse clerks including handling all but the heaviest equipment, toolkeepers in field and plant, truck driving, tank car and truck loading racks, pipeline walking, instrument repair and maintenance, laboratory helpers and chemists, automatic boiler firemen and chemists, and sample jerking.

This company explained that, since gasoline plant operations ordinarily do not reach the high temperatures and pressures encountered in complicated equipment of refineries, women could handle many of the operating jobs after a training period of perhaps 6 months. Preferably a trainee for a job of this type should already have worked in other departments of the plant, notably laboratory and material transfer and warehouse.

Study Conditions of Each Job

General classifications of work for women in oil company plants will be hard to set up, authorities state, and conditions of each individual job will have to be given the most consideration. Many jobs in the above list will be found suitable for women in one plant and unsuitable in another. For example, carpenter shop, painting, oiling, machine shop, firing, and pipefitting work in all but extremely large plants frequently entail extensive outside, heavy labor in the field; impossible for women. Welding in most plants also would have this objection.

Many question the advisability of using women as gatemen in wartime. Tank gauging in many plants is considered one of the "toughest" jobs, entailing climbing high tanks and tank cars in all kinds of weather—definitely unsuitable for women and hard for many men. Some consider sample jerking in the same category, although others would confine it to picking up samples taken by the operating and gauging crews and conveying them to the laboratory.

A pump operator in many plants must overhaul his pumps when necessary; know what is wrong with them and what to do about it—without being told—in an emergency in order to quickly get back on stream.

Some companies which have no definite retirement programs save the easy jobs for superannuated employees who are still able to do some work or simply make a job for them. In some instances their present work can be done by women and these older workers in the emergency used in more responsible jobs.

Still-operator's jobs cannot be handled by women by reason of the long training and necessary "inside" knowledge of other operating jobs in the plant, many refinery heads say, pointing out a still-operator can make much grief for other operating departments without intending to do so. In all but the larger plants, a woman could not be kept busy just handling the paper work most still-operators must do. The operator must read the instruments in order to operate, and frequently these are of the recording type.

Jobs Easily Filled by Women

But women can be excellent laboratory helpers; they have the necessary patience and nimble fingers to do routine work well. There is no reason a woman could not drive a light truck as well as any man. A husky, healthy woman can be an excellent pipeline walker; nowadays all a man can do is locate the leak and send for the repair crew.

Women will make excellent oilers and wipers; they are reported by other industries to take more pride in the work and keep the engines cleaner than men. They can be trained to do excellent general instrument repair and maintenance work after 3 to 4 months instruction, it has been learned in other industries.

Tool room work can be done by women, except for the heavier tools where the driver of the truck sent for them could do the lifting. Servicing recording instruments and bookwork in the field for natural gasoline and production companies can be done by women, using a horse, bicycle or a car, as conditions require. Some oil companies are already studying what is described as "re-engineering" of jobs, so that the heavy labor can be concentrated for men and the light work given to women. General practice is to require women not to lift over 25-35 lbs.

Most plant jobs for women will require special clothing. In general this is slacks with

slash pockets, but without belts, flowing or baggy sleeves, ties or cuffs which might catch in machinery; low-heeled comfortable shoes with "safety toes" where necessary and caps to confine the hair. "Flashy" or conspicuous clothing is to be avoided at all times within the plant, even when coming to or leaving the job, employment managers say. Such field duties as meter servicing and pipeline walking will require overalls.

Qualifications for Jobs

At present, many companies are hiring women from the community near the plant rather than outside. Some prefer wives and daughters of employes. For technical and college-trained employes they consult the U. S. Employment Service, colleges, and their own personnel departments.

Women from the community and from employe's families are preferred for several reasons. Among them are the elimination of the housing, social and transportation problems. Such women also frequently have some knowledge of the refinery or natural gasoline plant and know how to meet and get along with the men they must work with.

Few companies now will bar an applicant because of age or marital status, providing they are over 18 and, generally, under 60. Some require at least high school education where technical training is not a "must". One company is planning to extend its aptitude tests for stenographers and certain clerical jobs to the new job classifications for women. Many companies look scrupulously at the applicant's background, since "you can only protect women who want to be protected".

All undergo the same investigation as men for indication of anti-American leanings and when employed they are finger-printed and given identification badges the same as men. One large company is considering establishing day nurseries, charging less-than-cost fees to take care of children 6 months to 6 years old, if married women with children are employed in sufficient numbers to justify it.

Job Training

Training women for new plant jobs may prove to be a headache, some personnel men say. Others will solve this in the same way they train new men—teaching them on the job by men who not only know the work but also how to teach others how to do it. A few companies expect to hold indoctrination courses for a week or 10 days prior to active duty in which the general phases of the work will be taught, preliminary safety instruction given and clothing requirements explained. These courses will be in charge of competent instructors.

One company having lost approximately 14% of its personnel to the armed forces, is now instituting a school to train women to handle routine tests on petroleum products. The first 2 classes, of 15 women each, will begin shortly; when "graduated" they will replace men testers. Training for other jobs will be included later in this company's program. This experience will help in establishing training procedure for other jobs.

Hire 'For the Duration'

Opinion is divided on whether women will be hired "for the duration" or on the same basis as in peacetime. Some companies believe their experience with women will lead to permanently retaining them in some jobs formerly occupied by men. Others are hiring "for the duration", as they plainly tell all new workers. Others say they will "just hire women and make no commitments".

Companies in the first group will shift male employes who return from military-leave-of-absence to other jobs having equal or higher rates of pay and responsibility. This they say is in accordance with the legal and moral obligations imposed by the Selective Training and Service Act of 1940.

Those taking the second course for the most part plan to return men to their old jobs, dropping out the women as rapidly as old employes return to duty or other men become available. One company hiring "for the duration" will permit women to attain seniority; however, it is anticipated they will be "frozen" at their jobs insofar as progression under the "up grade" system is concerned. This provision also will partly apply to men hired since the draft began, who will be retrograded sufficiently to permit returning employes on military leave to their old jobs.

Those in the third group plan to keep such capable women as they have room for; this also will apply to men hired since the draft law was passed.

Union's Attitude Towards Women

According to some companies, there is considerable opposition on the part of union members in closed-shop plants to working with women, although many of them perforce are changing their attitude as they come to realize the seriousness of the labor situation. Other unions are accepting the idea and are said to be taking the women into their ranks as a matter of course on the same footing as men.

One company will not hire a woman unless and until she is accepted by the union; she goes straight from the personnel department to the union hall, to return with her card before going on the job.

One company used a unique approach to "selling" an obviously skeptical union on the manpower scarcity. One employe, a high official of the local union, was relieved of his regular job, given an expense account, and instructed to recruit all available men for the labor gang, using whatever procedure he deemed necessary.

He was authorized to offer standard company wage rates to prospective employes possessing the minimum necessary qualifications. After 2 weeks he had acquired many less than his estimate and was begging to be returned to his old job. This union now is convinced the manpower shortage is as serious as the management maintained, and is not an "undermining scheme".

As to the women's attitude towards the unions: More than one employer said the women object to paying for the privilege of holding a job, especially since the job will last only through wartime. Several reported women were joining the unions and said there had been no "kickbacks" from either side.

One point which the unions have brought up, which management recognizes, is the interference with the operation of the "up-grade" system almost universally used. Obviously, women can not start on the yard gang and progress through higher job classifications inasmuch as they are not physically qualified to perform the duties of these labor groups, and must be placed on jobs for which they are capable. This may temporarily retard progression of male employes from these lowest classifications until a vacancy exists in a still-higher classification; then they can be "skipped over" the classifications women may fill. The only workable solution suggested is to negotiate with the union as these cases arise.

'Conditioning' the Men

Apart from the union question, the men on the job must be conditioned for the influx of women, oil company personnel men stress. One company is advising foremen with respect to probable military losses and the need for employing women. The foremen in turn explain the situation to the men, and urge their cooperation in an emergency wartime undertaking.

Any employer takes on a definite moral responsibility when he introduces mixed help into his operations whether or not he recognizes it, one refinery superintendent maintains. It's up to him to see that she is given adequate protection at all times she is within the plant—and in isolated localities protection to and from work, especially at night. This situation is to be explained to the men, the company feeling that the majority of them will take it upon themselves to see that the women workers get any needed protection.

Restrictive Laws Studied

Many oil companies contemplating using women in plant jobs now have their legal departments investigating any restrictive state legislation, although the length of the working week and the compensation paid in the oil industry is well above the minimums prescribed by law.

In some states the law prohibits women under 18 working between the hours of 6 p.m. and 6 a.m. In one state an oil company is handicapped in hiring women chemists because of the law limiting the number of hours a day a woman can work, unless she is classified as a professional woman, and the classification at present does not include chemists. Frequently in research laboratories the work is at a stage where an operator cannot drop a test when the whistle blows but must carry it through to the final results. This company is reluctant to take women on its research staff under this condition but hopes to have the law amended to define a trained chemist as a professional woman.

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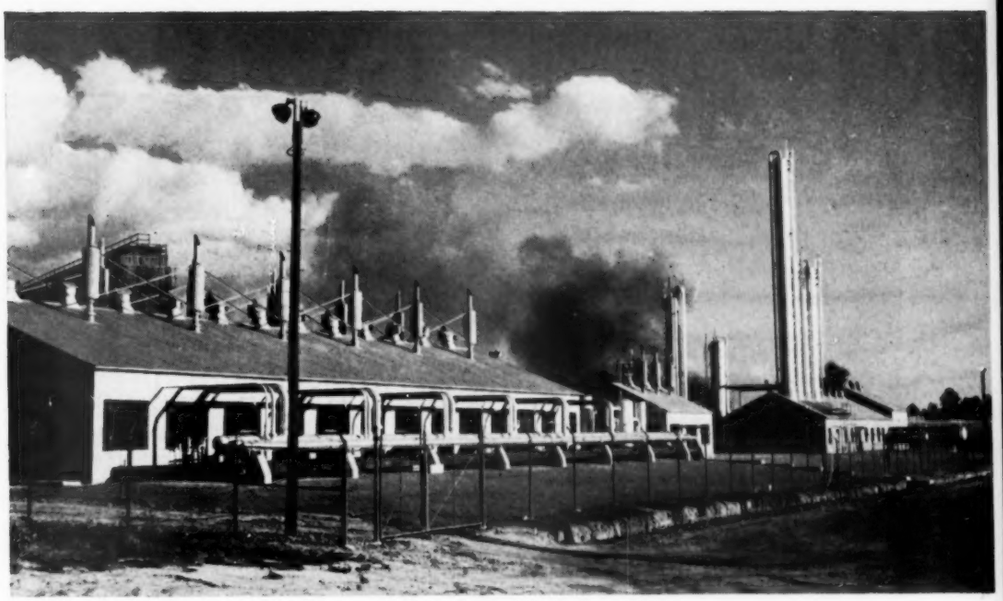


War model gasoline plant of Warren Petroleum Corp. at Crossville, Ill.

Maximum LPG Yields

Sought By Wartime Gasoline Plants

NATURAL gasoline plant operators are giving much attention these days to means for improving production of liquefied petroleum gases through existing equipment or through whatever equipment can be improvised under today's emergency shortages of materials. These LPG products can be listed as butane, isobutane and isopentane in the order in which they can most easily be produced in gasoline plants.

The plant operators realize that to the extent to which they increase their yields of these products even at the expense of their natural gasoline output, they are serving in the petroleum industry's war effort. Butane requirements are growing as the aviation gasoline and synthetic rubber programs expand. Demand for isobutane as a component of aviation gasoline is increasing. It is anticipated that isopentane will be needed as an aviation gasoline blending agent.

Also, looking into the future, authorities believe that the present participation of the natural gasoline industry in the war program through supplying the maximum possible volumes of the LPG cuts will best fit it for post war operations. These same products, as far as can be seen now, will continue in demand for motor and aviation fuels, synthetic rubber, chemicals, plastics and other products, the raw material for which will come from petroleum. The establishment by the natural gasoline industry of its plants as a source for these materials will help its post-war markets and may even influence the locating of plants to manufacture chemical and synthetic products.

Present-day natural gasoline plants, operating on "fairly rich" gas, for maximum yields of liquefied petroleum gases for wartime needs, produce at a ratio of approximately 40% natural gasoline of controlled vapor pressure, 32% normal butane, 8% isobutane and 20% propane from the total raw gasoline produced. A somewhat more efficient plant will produce up to 29% butane, 10% isobutane and 25% propane, and 36% natural gasoline, some authorities state.

Seek More Efficiency

This shows the increasing tendency, especially apparent in the last 2 years, to put in more expensive and larger plants to obtain greater LPG extraction efficiencies. At first the designers aimed for 95% butane extraction, later upping efficiency to extract 95% of the isobutane. At present, designs call for 50-60% propane extraction, which automatically makes sure all butanes are recovered. The highest efficiency obtained now is approximately 60% propane extraction when operating at 600 lbs./sq. in. pressure, and unless the demand for propane develops further, some authorities believe efficiencies may have about reached their practical upper limit in extracting LPG cuts.

In order to increase efficiencies of extraction, 3 possibilities are open for plant operators:

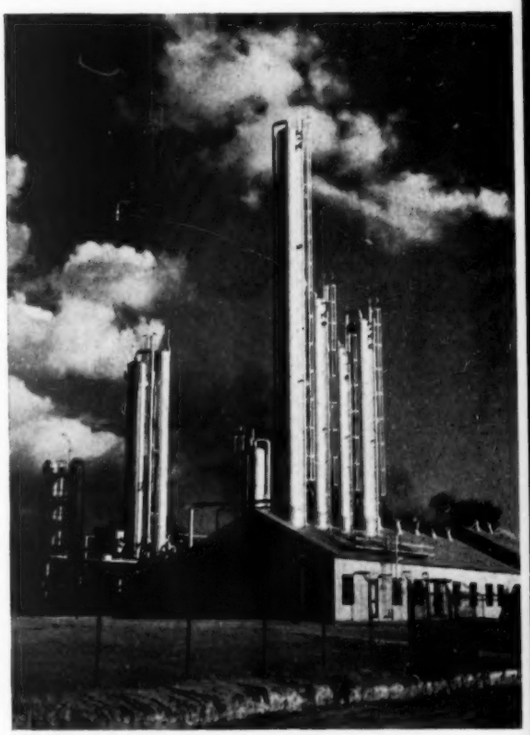
(1) use more absorber oil (or increase circulation);

(2) increase absorber pressure; or

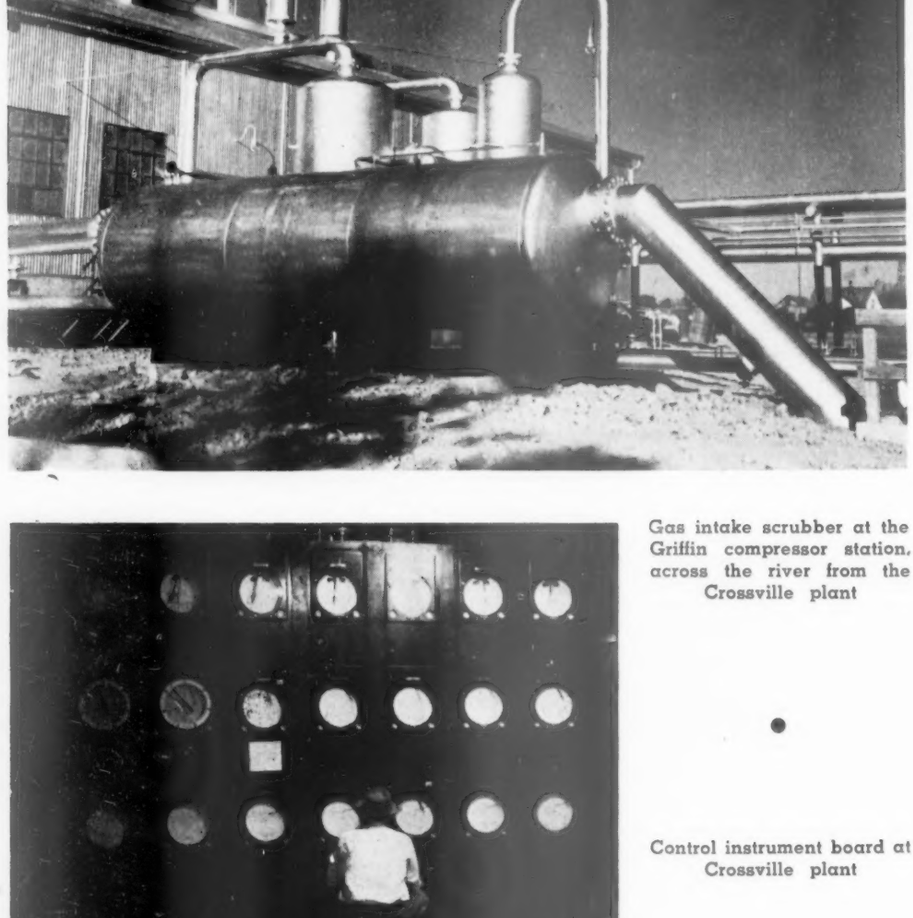
(3) absorb at lower temperatures (refrigeration).

Any one of these possibilities may be utilized, or a suitable combination of them. (*See NPN May 27, p. R-170, for more detailed discussion—Ed.*)

In the past, when a manufacturer wished to provide special cuts, or more cuts, the simplest procedure was to design a new plant with more efficient fractionation towers. But now, and for some time to come, it will be necessary to use second-hand equipment, or perhaps equipment fabricated from reclaimed metal, because of both the time factor involved in obtaining deliveries of equipment and the shortage of steel. This requires searching the junk yards and improvising

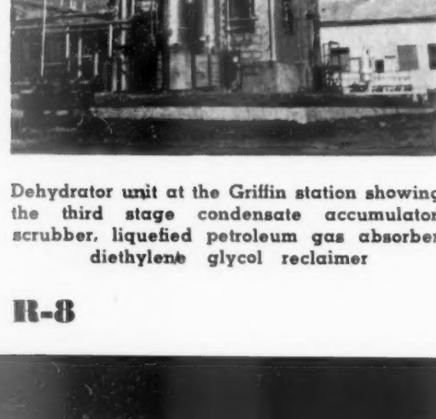


Still and fractionator columns at Crossville plant. Left to right: two Florite dehydrators, fat oil stabilizer, combination still and dephlegmator, de-isobutanizer, depropanizer, de-ethanizer, and natural gasoline stabilizer



Gas intake scrubber at the Griffin compressor station, across the river from the Crossville plant

Control instrument board at Crossville plant



Dehydrator unit at the Griffin station showing the third stage condensate accumulator, scrubber, liquefied petroleum gas absorber, diethylene glycol reclaimer

Table I—Melting and Boiling Points of Principal LPG Products*

Hydrocarbon	Melting Point °F. @ Atm. Pres.	Boiling Point °F. @ Atm. Pres.
Propane	—305.9	—43.8
Isobutane	—229.0	+10.0
Normal butane	—218.2	+31.1
Isopentane	—257.1	+82.4
Normal pentane	—201.5	+97.0

*"Physical Constants of Paraffin Hydrocarbons"—Committee Report; Proceedings of Natural Gasoline Assn. of America, p. 8, May, 1942.

where necessary, as well as consulting OPC's list of available surplus equipment.

New Plants Make All LPG Cuts

Practically all new plants now being built are equipped to produce all the LPG products as chemically pure hydrocarbons: butane, propane, isobutane and in some cases isopentane. It is almost impossible to get priorities on material for plants which will produce "natural" gasoline alone, because it is not a war product. The war effort now requires LPG products, and WPB considers the steel required in a plant to be constructed solely to produce "casinghead" more vitally needed elsewhere.

Producing commercially pure LPG products requires fractionator columns which will make close cuts. This necessity is plain when the boiling points of the products shown in Table I are considered.

It is not practical to install alkylating or isomerizing units at most individual natural gasoline plants, according to the general opinion, because by their very nature "casinghead" plants are "here today and gone tomorrow". Isomerizing and like equipment is better built at more central and permanent locations, such as refineries, where there is less dependence on location for supplies of raw materials.

A representative major producer of natural gasoline and liquefied petroleum gases, Warren Petroleum Corp. of Tulsa, although not contributing finished products as such for the war effort, is supplying special cuts to refiners and chemical manufacturers as raw materials for war products.

These cuts are isopentane, a blending agent for 100-octane aviation gasoline having a 91-octane rating ('39 Research method) without additives; isobutane for alkylate; propane for synthesis of styrene, the co-polymer with butadiene which forms Buna-S rubber, and for organic chemical synthesis into diversified products; butane for conversion into butadiene; and natural gasoline for blending with naphtha into motor fuel as well as for conversion into butadiene by Standard Oil Co. of Indiana's process.

Demand for LPG Soars

Sales of all liquefied petroleum gases by this company in 1941 totaled 70,000,000 gal., while 1942 sales, up to September, already have exceeded the total sold in 1941. The tremendous increase in peacetime demand for LPG from domestic and industrial consumers, as illustrated here, has made it necessary for the entire natural gasoline industry to increase its facilities yearly; and now that the war effort is making large demands for liquid petroleum gases for further processing, this peacetime expansion is looked on by many as a major blessing in disguise.

Illustrative of war-model natural gasoline plants is Warren's recently completed plant at Crossville, Ill., which forms a part of a cooperative repressuring project in the Griffin-New Harmony areas of that state. A brief description of this plant follows:

Plant Process Described

Repressuring program calls for injection of residue gas from the plant at a pressure of 600 lbs./sq. in.; accordingly, wet gas from the

field is supplied to the absorbers at that pressure, after first being cooled and pressure condensate being dropped out in a high-pressure surge tank. The third-stage, high-pressure condensate enters the surge tank where it is flashed to 70 lbs./sq. in. gauge pressure. Vapors from this tank are charged to the fat oil stabilizer; liquids flow directly to the raw gasoline receiver.

Raw gas from the high-pressure surge tank enters an 18-tray absorber which is controlled for total isobutane extraction. Stripped gas is returned to the field after dehydrating, while the rich oil goes to a fat oil stabilizer before reaching the stripping still—a new wrinkle in gasoline plant design.

A 26-tray fat oil stabilizer operating at 65 lbs./sq. in. pressure is inserted ahead of the stripping still to remove the large quantities of methane and ethane which are unavoidably absorbed at the high absorber pressure employed. In this way, handling large volumes of undesired gases in subsequent operations is avoided; otherwise, much larger (and more expensive) stabilizing and de-ethanizing equipment would be required.

Rich oil bottoms from the fat oil stabilizer are charged to a fat oil stabilizer surge tank, which is, in effect, a three-element multitubular heat exchanger as well as a reboiler, where necessary stripping temperature is attained before the stabilized fat oil enters the still. Overhead gases from the fat oil stabilizer, assaying on the average 43.51% methane, 31.83% ethane and 24.66% propane, are utilized as boiler and compressor fuel, with any excess vented to flares.

The still is a conventional 15-plate column, from which overhead goes to the raw gasoline receiver after condensation, and the bottoms, lean oil, are returned to the lean oil surge tank.

Raw gasoline from the receiver is fed into the centerplate section of a 36-plate stabilizer operating at 308° F. and 250 lbs./sq. in. pressure. Bottoms from the stabilizer are natural gasoline of controlled vapor pressure, while butanes and lighter fractions go overhead through condensers into a reflux tank beside the stabilizer. Part of this condensate is utilized as stabilizer reflux, while the excess is charged to the de-ethanizer.

If it is desired to produce isopentane, the stabilizer is controlled so as to completely debutanize the raw gasoline. Bottoms would then be charged to an additional 70-tray tower operating at 50 lbs./sq. in pressure and 192° F. There, isopentane would be recovered overhead and bottoms passed to gasoline storage. The Crossville plant is not equipped at the present time to recover isopentane.

Stabilizer condensate is charged to the de-ethanizer, a 30-plate tower operating at 400 lbs./sq. in. pressure and 187° F. Ethane and lighter, together with some propane, is recovered overhead and vented to flares. Bottoms pass through a sodium hydroxide scrubber into a surge or settling tank.

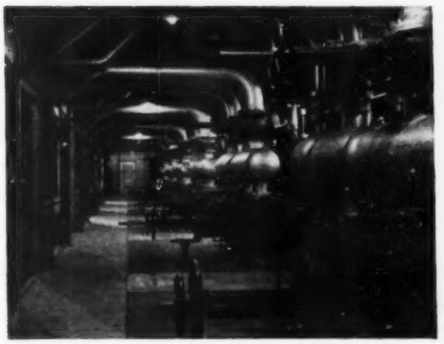
A pump takes suction from the surge tank, charging the liquid into a 36-tray depropanizer operati g at 185° F. and 250 lbs./sq. in. pressure. Here the commercially-pure propane goes overhead through condenser and reflux tank to storage. Bottoms, butanes, flow directly to the de-isobutanizer.

The butane-splitter, or de-isobutanizer, is a 60-tray column operating at 130 lbs./sq. in. pressure and 158° F. The 2 products of this column, butane and isobutane, are recovered as bottoms and overhead, respectively, flowing through coolers and condensers directly to storage as commercially pure products.

The last 2 towers, the depropanizer and the de-isobutanizer, each are designed for constant heat input to the reboiler through a flow-controller in the steam line, and the top tray conditions are maintained constant with respect to temperature and pressure. Temperature control is through reflux, controlled by an electronic-type controller, the thermocouple of which is installed on the top tray. Pressure is maintained by a controller operating in the overhead vapor line.

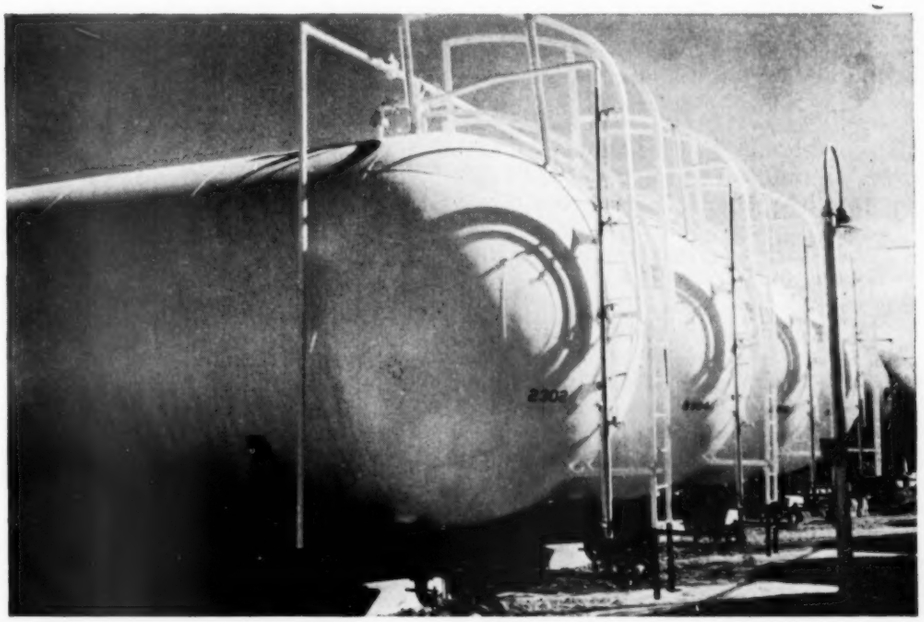
Design to Save Equipment

The adoption of any special emergency wartime standards in the building of new plants is not necessary for this company. It always has been Warren's practice to build simply—"just what we need and no more." All excess standby equipment is eliminated. Where it is necessary to have standby equipment, such as pumps for example, design permits handling as many as 4 services wherever possible. The company also is complying with all WPB and OPC requirements and recommendations as to use of metal in ladders, walkways and other metal-saving suggestions.



Row of compressors at the Crossville gasoline plant

Dehydrator, absorber and absorber scrubber tank at Crossville plant



Natural gasoline storage tanks at Crossville plant

Corrosion Control in Refinery Pressure Vessels By Arc Welded Stainless Steel Linings*

Conservation of high grade steel in the wartime emergency is being effected by Pure Oil Co. by a standard method for applying stainless steel linings to refinery pressure vessels in service, by arc welding. The procedure calls for careful layouts, calculations and preparation of templates preliminary to the application of the linings, which contribute to lowering the cost.

Advantages of the strip welding method over plug welding have been found in the conservation of materials and labor, since the linings are more readily formed to the irregularities of the vessel without excessive warping and twisting. The procedure is said to be equally applicable to new vessels, also to linings of other materials.

Before its adoption of stainless steel linings, the company experimented with other means for protecting pressure vessels from corrosion, including carbon steel and gunite linings and sprayed metal coatings. Its studies have shown the present standard method to provide the lowest cost based on the life of the various linings.

The accompanying paper describing this method of applying stainless steel linings is the $3700 prize contribution in the maintenance classification in the recent $200,000 scientific welding study program sponsored by the James F. Lincoln Arc Welding Foundation of the Lincoln Electric Co., Cleveland.

By W. W. McClow**

The most common reason for installing stainless steel linings in refinery pressure vessels is to combat high temperature corrosion. Any vessel such as a fractionating tower, evaporator, accumulator, etc. which is subjected to corrosion will ultimately be reduced to its minimum safe wall thickness for the pressures and temperatures involved. Unless some definite protection against corrosion is provided before this point is reached, extensive damage may result.

The oil industry has tried various methods other than stainless steel linings for controlling corrosion. Among these are brick linings, cast concrete linings, various types of sprayed ganister and cement coatings (ordinarily known as gunite), various kinds of protective paints, sprayed molten metal coatings, chromium plating, and welded carbon steel linings. Experience with several of these methods and investigation of the remaining ones has revealed that, from standpoints of economy, durability, and prolonged corrosion resistance, they are not to be compared with the much superior arc welded stainless linings now used so extensively throughout the industry.

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Stainless linings are often installed in new vessels at the time of fabrication. Obviously this is the most economical procedure, not only because the surface is clean but also because all welding can be performed downhand and the welders can work unhampered by such obstructions as trays, baffles, and other accessories.

While this method is preferable where it can be applied, it has no application in the extensive use of field welded linings in existing vessels which are approaching their minimum safe wall thickness. The installation of a lining in such a vessel often provides the choice between completely renewing the vessel at an enormous capital investment or prolonging the life of the old one for an unlimited period of time.

The present standard adopted in our plant for vessel linings is a No. 12 BWG (British Wire Gauge) (0.109 in. thick) 12-14% chromium, 0.08% maximum carbon, stainless steel. However, it is understood that some in the industry have employed various thicknesses ranging from 1/16-in. to ⅛-in., also a number of compositions containing varying percentages of chromium, nickel, molybdenum, carbon, columbium, and titanium.

While the thinner material is cheaper and more easily formed to the irregularities of a vessel shell, it is extremely difficult to apply because of its tendency to burn away under the arc. A welder must have considerable experience in its application to obtain a satisfactory job. For these reasons, it is ordinarily advisable to specify the heavier sheet.

The carbon content should always be the lowest possible to reduce embrittlement, which often occurs in the sheet next to the fusion line of the weld. Such embrittlement is caused during the welding operation by the formation of chromium carbide between the grain boundaries of the steel. Until recently 0.08% was the lowest carbon content ordinarily obtainable commercially; however, it is understood that 0.06% is now available.

The two most commonly used methods for field applications of stainless linings are known as "plug welding" and "strip welding." For plug welding the sheets are perforated with holes on relatively close centers. The sheets are fastened to the shell by welding through these holes as well as along the edges. The holes generally range in size from 0.5 to 1 in. depending upon the preference of the designer and the technique and experience of the welders to be used.

Spacing of the holes may vary from about 2.5 to 6 ins. depending upon the service conditions of the vessel. Generally the higher the temperature, the closer the spacing. For strip welding the sheet is furnished in narrow strips generally from 3 to 4.5 ins. wide which are attached to the tower only at the edges. In this case also, the higher the temperature, generally the narrower the strips.

In our experience with the 2 types of linings the strip type has been found preferable for the reason that it is more readily formed to the irregularities of the vessel shell without the excessive warping and twisting which is often experienced with the wider sheets employed in the plug weld method. The strip method also allows the strips to be butted while the plug weld method generally necessitates that the sheets be lapped to compensate for the distortion described above. Lapping represents a waste of material and is another reason for adopting the strip method.

This presentation will deal with the field application of an arc welded stainless lining of the strip type to an existing pressure vessel, described as a cracking still bubble tower with an inside diameter of 8 ft., 6 ins., a height of approximately 104 ft., and an original wall thickness of 19/16 ins. This vessel is typical of several in our plant to which stainless steel linings have recently been applied by arc welding.

It should be borne in mind that while the

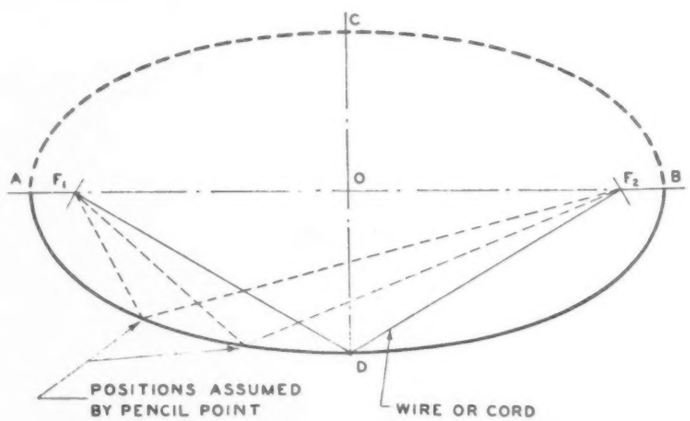

Fig. 1—Method of producing the semi-ellipse for the ellipsoidal tower head in the preparation of templates

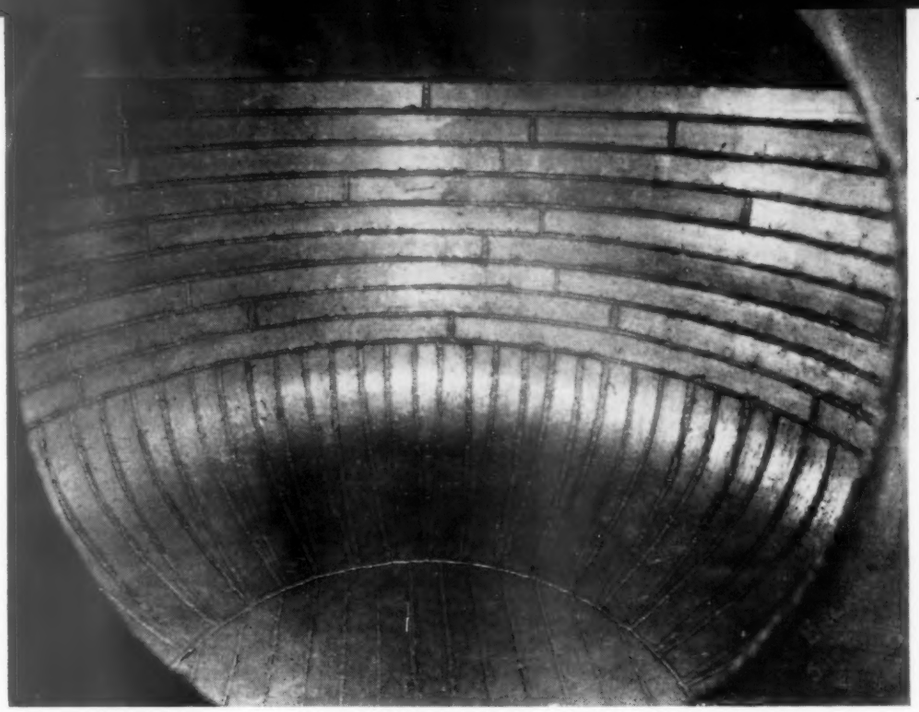

Fig. 7—Bottom section of bubble tower through the manway, illustrating the method of applying stainless steel strip lining to circular patch in bottom, to the head and to the side walls of the tower

discussion deals with a field application, all the procedures and layouts described are equally applicable to new vessels under shop fabrication. It should also be noted that these methods are not necessarily confined to either use of stainless steel or to the application of linings to refinery vessels. In fact they may be applied to the installation of any sort of weldable sheet metal lining to practically any type of vessel.

Materials used in this work were as follows: Tower shell was A.S.T.M. No. A-70-36 flanging grade firebox steel, originally 1 9/16-in. thick but reduced through corrosion to approximately 1 3/16-in. Lining material was No. 12 BWG 12-14% chromium, 0.08% maximum carbon hot finished stainless steel strip, 4 ins. wide, pickled and furnished in reel form. Welding rod was ⅛ and 5/32-in. Lincoln Stainweld "A" stabilized with columbium. Welding machines were Lincoln Type SAE "Shield Arc" 300 amp. direct current. No. 11 silica blast sand was used. All tower surfaces which were to be lined were thoroughly cleaned and sandblasted before proceeding with the welding operation.

Application of Lining to Bottom Head

General Description

The tower head under discussion is described as a semi-ellipsoidal surface generated by a semi-ellipse rotating about its minor axis and having a ratio between its major and minor axes of 2 to 1. Such a surface is known generally as an ellipsoid of revolution or specifically as an oblate spheroid.

Although this discussion deals with a head having the shape of an oblate spheroid, it should be noted that the same line of reasoning and lay-out methods would be equally applicable to prolate spheroids as well as the sphere itself, although there is no evidence available to indicate that the former is used to any extent for refinery vessels. A prolate spheroid is distinguished from an oblate spheroid by the fact that it is generated by an ellipse rotating about its major axis instead of its minor axis. The sphere is a special case of the spheroid in which the major and minor axes are equal in length.

Basis for Selection of Design

After having reviewed past experiences with tower head linings, it was decided that an effort should be made to reduce costs of liner application and if possible to produce a more satisfactory installation in general. Accordingly, preliminary lay-outs and templates were made in the office to determine the limitations of various conceivable designs.

Referring to Fig. 6, which is a photograph showing the design finally adopted, it was found that at least one ring of radial strips would be needed to produce conformity to the sharp change of curvature occurring at the outer extremities of the semi-ellipsoid. It was evident that the most economical design would result from only one such ring, this to surround a circular patch in the center and consist of alternate rectangular and wedge-shaped strips.

The inside diameter of the ring was calculated and laid out on the generating ellipse to determine the feasibility of the arrangement. The bottom portion of the ellipsoid proved to be sufficiently flat to permit the installation of a central patch of the calculated diameter and on the basis of this determination it was decided to adopt the design.

Calculations

In order to determine the proper number of radial strips required to build up the outer ring shown in Fig. 6, it was necessary to first decide upon the desired width of spacing between adjacent strips. Former experience had shown that by proper fitting and welding technique this spacing could be maintained at approximately 0.25-in. With this assumption calculations were carried out as follows:

Inside diameter of tower . . . . . 8 ft. 6 in. or 102 in.
Width of lining strips . . . . . 4 in.
Width of spacing between strips . . . . ¼ in.
Let N = Total number of radial strips
Then 4.25 N = 102 π
Solving, N = 75.4

Since it was desirable to have a whole number of strips for layout purposes and since it was also necessary to decide upon an even number of strips in order to carry out the alternating relationship between rectangular and wedge-shaped strips, the choice was limited to either 74 or 76 strips. It was decided more economical to adopt 76 strips and if necessary trim the wedge shaped strips slightly narrower than originally planned, rather than to fill in by welding the extra

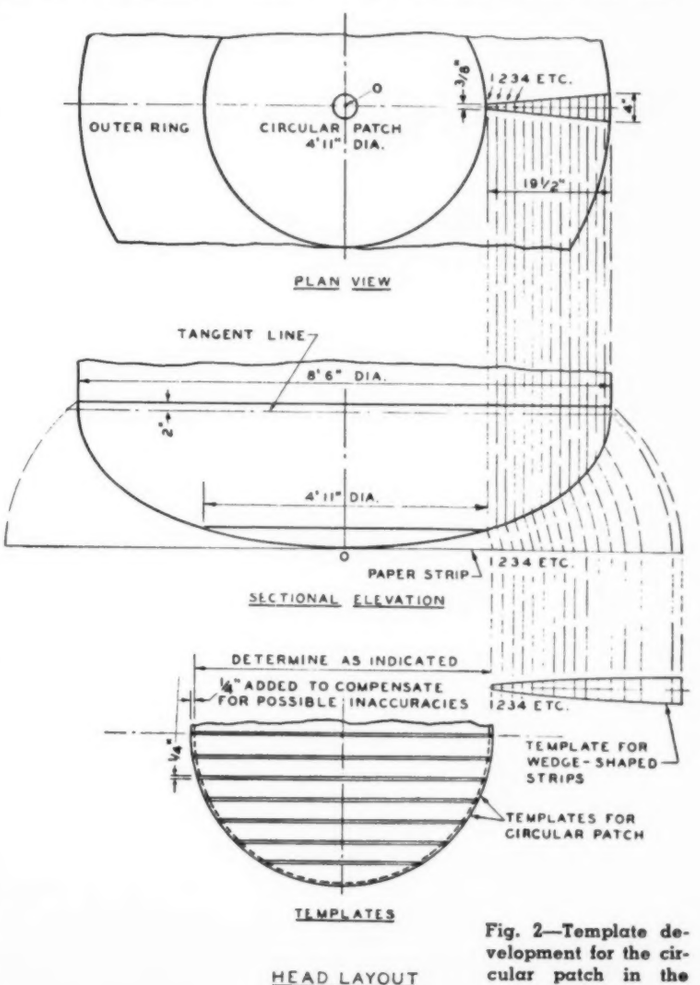

Fig. 2—Template development for the circular patch in the tower head

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spacing which would be created by using only 74 strips. Accordingly, the design was set up on the basis of 76 strips.

Inside Diameter of Ring

It was obvious that the wedge-shaped strips in the outer ring should not be brought to a point at the narrow end for the reason that the welds on opposite sides of the strip would fuse into each other as they approached the point and in effect be equivalent to nothing more than an excessively wide single weld. A width of approximately ⅜-in. was considered satisfactory for the narrow end and on the basis of this assumption, calculations were carried out as follows:

$$\text{I.D.} = \frac{(38 \times 4\tfrac{3}{8}) + (76 \times \tfrac{1}{4})}{\pi}$$

Solving, I.D. = 59 in. or 4 ft. 11 in.

Preliminary Lay-out

It is obvious that after the lining design had been adopted, templates could have been developed on the job as installation progressed. However, preliminary lay-out work and template development was considered advisable in order to check the feasibility of the design before installation and to determine the most economical lay-out from the standpoints of scrap loss and labor requirements for cutting liner material into the desired shapes.

Development of the Ellipse

The following development was carried out for the purpose of reproducing the semi-ellipse used in generating the ellipsoidal head under consideration.

By definition an ellipse is the locus or path of a point which moves so that the sum of its distances from two fixed points remains constant. The fixed points are known as the foci and the sum is equal to the length of the transverse or major axis.

Referring to Fig. 1, AB is the major axis and CD the minor axis. For the particular tower under consideration AB was drawn equal to the tower diameter of 8 ft. 6 in. Since the ratio between the major and minor axes was 2 to 1, the length of the minor axis was 4 ft. 3 in. The lengths of the two axes were the only known quantities and therefore were necessarily the basis for further development.

Foci F_1 and F_2 were located by cutting the major axis AB with an arc having its center at C or D and a radius equal to AO or OB. Nails were driven at points F_1, F_2, and D and a flexible wire was drawn tightly around D with the ends tied at F_1 and F_2 as indicated. The ellipse was described by removing nail D and moving a pencil point in the loop in such a manner as to keep the wire taut at all times.

Although there are several other methods of drawing ellipses, some of which are accurate and some approximate, the method described is probably the best suited to developing a true, full-size ellipse of the dimensions specified.

Development of Circular Patch

The following development is approximate and was carried out primarily for the purpose of providing templates for cutting strip lining into shapes which could be fitted into the desired circular patch with a minimum of final trimming.

Template development for the circular patch was carried out as outlined in Fig. 2. Referring to the sectional elevation, the length of the elliptical curve lying between points 0 and 1 was determined by bending a paper strip to conform to the ellipse, marking at the above points, and measuring the distance between the marks after the strip had been straightened out again. It was considered advisable to add approximately 0.25-in. to this distance to compensate for inaccuracies which might exist in the tower head. A circle with its radius equal to this sum was drawn and then divided as indicated into 4-in. strips with approximately 0.25-in. existing between adjacent strips. The 4-inch strips thus formed represented the finished templates.

Development of Outer Ring

As previously stated, the outer ring in the particular case being described was composed of a total of 76 alternating rectangular and wedge-shaped strips.

A wedge-shaped strip was laid out in horizontal projection as shown in the plan view of Fig. 2. The center line of the wedge was divided into equal segments of convenient length, 1 in. being used for the case described. The end points of the segments were marked 1, 2, 3, etc., and lines perpendicular to the center line were drawn through these points to cut the sides of the wedge. Points 1, 2, 3, etc. were then projected vertically downward to the ellipse as shown in the elevation. Distances along the curve between successive points were laid out by bending a flexible strip to the contour of the ellipse, marking it at the points described and again straightening it out. The marks thus produced were projected to a new center line and a series of vertical lines were drawn through the projected points perpendicular to the center line and equal in length to corresponding lines in the plan view. The template was completed by joining the terminal points of the vertical lines as shown.

The foregoing development was essential to

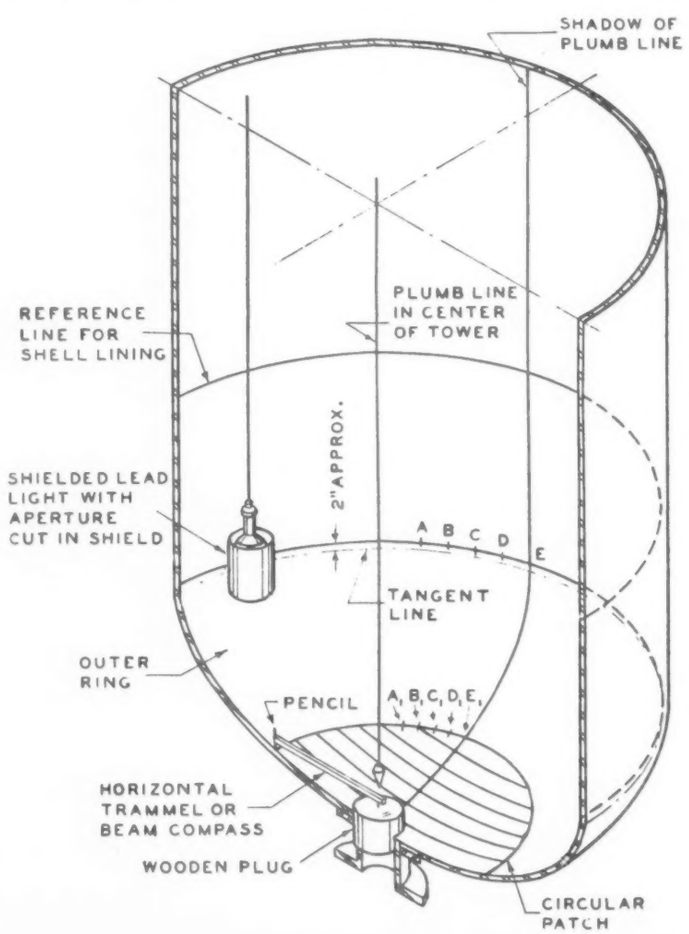

Fig. 3—Method for securing accurate lay-out of the tower head

TOWER LAYOUT

an intelligent analysis of the job. However, lining material was not cut according to the wedge-shaped template until all rectangular strips had been completely welded in place and an opportunity given for checking the template against the actual installation. In the particular case under consideration a perfect fit was obtained by using the original template; however, had there been any appreciable inaccuracies in fabricating the tower head or in carrying out preliminary lay-outs and calculations, it is obvious that alteration of the template would have been necessary.

All rectangular pieces in the outer ring were straight 4-in. strips equal in length to the wedge-shaped strips discussed in the paragraph above.

Lay-out of Tower Head and Application of Lining

In order to derive full value from the preliminary lay-outs, calculations, template developments, etc. already discussed, a highly accurate lay-out of the actual tower head was made preparatory to the lining application. Details of the lay-out used are outlined in Fig. 3.

Lay-out for Installation of Circular Patch

As shown in Fig. 3, a round wooden plug was fitted snugly into the bottom tower nozzle with the top at approximately the same elevation as the position designed for the edge of the circular patch. A wooden trammel was then fitted with a pencil at one end and a nail at the other, spaced so that the distance between them was equal to the radius of the patch in its horizontal projection. The trammel was placed in a horizontal position with the nail driven into the center of the plug and the pencil at the opposite end free to bear upon the tower head. A beam compass could have been used instead of the trammel had it been desired.

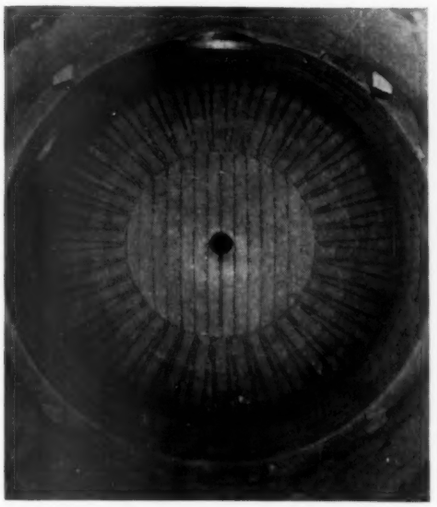

Fig. 6—Bottom head of tower after application of stainless steel lining

Installation of Circular Patch

After cutting strips according to templates previously developed, the installation was started at the center of the tower and carried outward simultaneously in both directions by installing the strips in pairs as indicated by the letters A. B. C. etc. in Fig. 4. Each strip was bent to the contour of the head, laid in place, and marked at the ends with the trammel. With the strip still in this position its inner edge was checked and marked to indicate the removal of any material necessary to produce conformity to the edge weld of the adjacent strip.

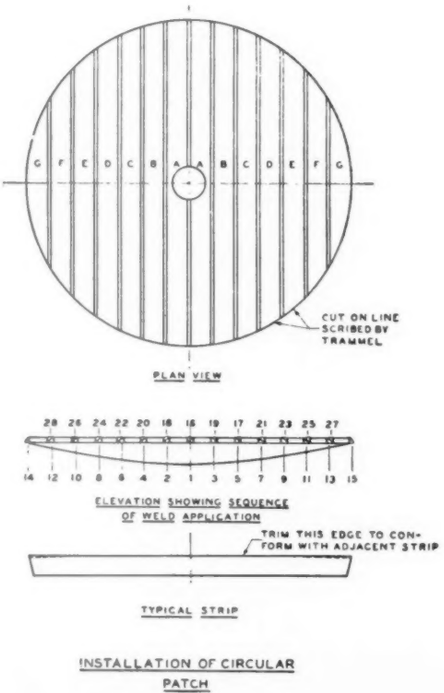
G F E D C B A A B C D E F G
CUT ON LINE SCRIBED BY TRAMMEL
PLAN VIEW
28 26 24 22 20 18 16 19 17 21 23 25 27
14 12 10 8 6 4 2 1 3 5 7 9 11 13 15
ELEVATION SHOWING SEQUENCE OF WELD APPLICATION
TRIM THIS EDGE TO CONFORM WITH ADJACENT STRIP
TYPICAL STRIP
INSTALLATION OF CIRCULAR PATCH

Fig. 4—Method for application of circular patch in tower head

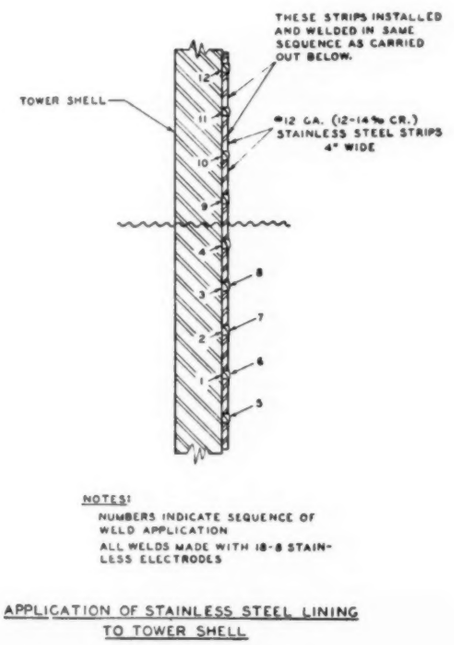

Fig. 5—Application of stainless steel lining to tower shell

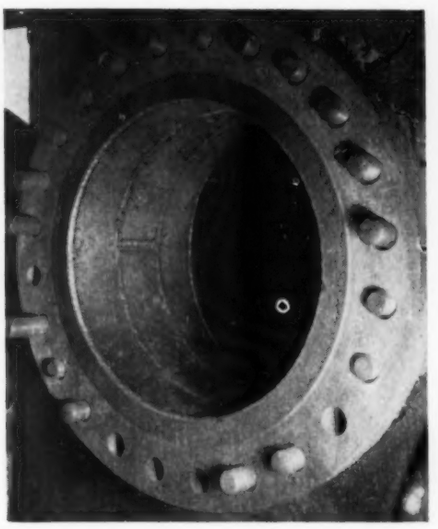

Fig. 8—View of manway lining

Trimming of the edge was required only by those strips which had to be twisted slightly to conform to the tower head. As shown in Fig. 4 the material removed was in the form of narrow slivers and in every case was cut from the edge near the ends of the strip. The amount of wasted material represented was negligible inasmuch as the pieces removed never exceeded approximately 12 ins. in length and 3/16 in. in width at the wide end.

After trimming, the strip was again laid in position and its edges welded, the inner with tack welds only and the outer with a continuous edge weld. Fig. 4 shows the approximate sequence adopted for weld application. As indicated, a continuous weld was applied first to one edge only and the sheet then allowed to cool thoroughly before completing the opposite edge with a similar weld. This procedure, accompanied by proper welding technique, was responsible for eliminating possible cracks resultant from contraction of the sheet. The extreme importance of welding with as low a current as possible consistent with proper fusion was recognized and all welds were made accordingly. Each weld was completed in two passes. The first took the form of an edge weld as previously stated and was run to slightly overlap the edge of the sheet in order to produce proper penetration. The second was run to slightly overlap the edge of the adjacent sheet and completely cover the first weld. This method proved to be very satisfactory and more economical than any other tried previous to its adoption.

Lay-out for Installation of Radial Strips

The method used for laying out the tower head preparatory to the application of alternate rectangular and wedge-shaped strips in the outer ring is shown in Fig. 3.

The circumferential reference line indicated was established by using a surveyor's level set up in the bottom of the tower and focusing the telescope upon a pencil point held

against the tower shell. It was decided to terminate the outer ends of all radial strips at a line running parallel to and approximately 2 ins. above the tangent line of the head. This position was determined by measuring down from the reference line and was chosen to make certain that all strips would run beyond any curvature in the head which might have existed above the theoretical tangent line due to inaccuracies in fabrication.

It was realized that, if the cost of this type of installation was to be kept at a minimum, all radial strips of a given kind should be exact duplicates, cut to a standard template. In order to meet these conditions it was evident that the center line of each strip should lie along a true element of the ellipsoid (an element appears as a radius of the head in its horizontal projection).

Accordingly, the circumferential line immediately above the tangent line was laid off in 38 equal segments, the ends of which are shown in Fig. 3 as A, B, C, etc. to designate center line positions for the rectangular strips. A plumb line was then hung in the exact center of the tower to coincide with the axis. Shadows of the string were cast upon the tower shell by using a lead light covered with a shield in which there had been cut a vertical aperture approximately 1/16-in. wide.

Geometry states that a plane is determined by a line and an external point. In this particular case the plumb line satisfied the first condition while the light fulfilled the second. Together they determined diametral planes which intersected the tower shell in the form of shadows. It is obvious that, since all planes thus formed passed through the axis of revolution of the ellipsoidal head, all shadows falling on the head lay along true elements of the ellipsoid.

The light was moved so the shadow of the plumb line passed progressively through points A, B, C, etc. For each of these positions the intersection of the shadow with the edge of the circular patch was marked. These points, indicated by A_1, B_1 C_1, etc. in Fig. 3, were prick-punched for permanency.

Installation of Radial Strips

The first rectangular strip was installed with one end at A and the other at A_1 such that its center line passed through the points. One edge was welded with a continuous edge weld while the other was tack welded.

After all 38 strips had been installed in this maner the tacked edges were completed with continuous welds applied in the same sequence used for installation of the strips.

The template previously cut for the wedge-shaped strips was checked against the spaces existing between the rectangular strips, and excellent conformity was found. Strips were cut according to the template and installed in a manner similar to that described for the rectangular strips. Tack welds were applied to one edge while a continuous weld was run along the other to slightly overlap the edge and cover completely the weld previously applied to the adjacent rectangular strip. After all wedge-shaped strips had been installed, the tacked edges were completed in a manner similar to that just described.

Application of Lining to Shell

A 12-gauge stainless steel lining in the form of 4-in. strips was applied to the tower shell as shown in Fig. 7.

Lay-out of Tower Shell

In order to facilitate accurate fitting of the lining strips, circumferential reference lines were drawn in true sections of the tower. As discussed under head lay-out, the first of these, indicated in Fig. 3, was established by using a surveyor's level.

As the installation progressed upward, successive lines were laid off as required by measuring back to the preceding line.

Accurate fitting of the strips was made possible by keeping their edges parallel to the reference lines described, thereby preventing the twisting of sheets and a resultant lack of uniformity in spacing.

Fitting and Welding

All strips were fitted and welded as shown in Figs. 5 and 7. As indicated in Fig. 5, all work proceeded from the bottom to the top of the section being lined. Each successive strip was installed by moving it down until its bottom edge came into contact with the edge weld of the strip below. The bottom edge was then tacked in place and a continuous edge weld run along the top edge.

Four or five complete rings were thus installed before dropping back to weld the bottom edges, which were completed in the same order. By this method, time was allowed for dissipating the heat produced by welding the top edges. As a result, cracking of the sheet was reduced to a minimum. All bottom edge welds were applied as shown, by producing a sufficiently wide bead to slightly overlap the edge and cover the weld previously laid along the top edge of the sheet below. All welds were thus completed in 2 passes, every effort being made to reduce deposition of weld metal to a minimum consistent with good practice.

Application of Lining to Manways

Fig. 8 is a photograph showing the application of 4-in. strip lining to a tower manway. The same procedure was used in this installation as already described for the application of lining to the tower shell.

Discussion of Lining Costs

The following discussion of costs of several types of vessel linings is summarized from the report.

When the program for lining pressure vessels with stainless steel linings was first adopted, it became apparent that the cost was too high. By the improvement of layouts and procedures, costs were successively reduced, the program culminating in the procedure described in the report, which was adopted by Pure Oil Co. as standard in March, 1940. It is noted that the work was performed by outside welders but had plant welders been available for the various jobs, costs would have been lower.

In comparing costs of various methods of protecting interior walls of vessels from corrosion, a figure of 15 years was assumed for the life of stainless steel lining, although it was believed it would last almost indefinitely for the services encountered.

Arc Welded Carbon Steel Lining (0.75 in. head lining, 0.5 in. shell lining)—Cost by this method was approximately $12.62 per sq. ft. Life was estimated as 4.5 years, making the cost per foot per year $2.81.

It was stated that the high cost of this type of lining was partly due to the scarcity of skilled welders at the time and partly to having to repair some of the completed welds after they had broken loose because of stresses set up during the cooling period for the vessel. The latter condition was considered an inherent disadvantage of a heavy lining of this type.

Gunite Lining—Approximate cost was $3.11 per sq. ft. Life of the lining was estimated at 1 year, 3 mos., making the cost per sq. ft. per year $2.49. While the gunite lining was not removed until 15 months had elapsed, it was giving little protection at the time of removal.

Sprayed Metal Coating — Several experiments were conducted to determine the practicability of corrosion control by means of molten metal spraying. Corroded sections of a tower shell were thoroughly sandblasted and coated with aluminum sprayed from a metal spray gun. While these tests were not regarded by the company as extensive or conclusive, the results obtained indicated the method inferior to stainless steel linings, largely because of the tendency of the coating to peel off after being subjected to operating conditions. No cost data was kept for these experiments.

Arc Welded Stainless Steel Lining—Total labor, material overhead and miscellaneous costs for lining the bottom tower head (83 sq. ft.) were given as $4.28 per sq. ft.; for lining the tray section of the tower (191.4 sq. ft.) $6.29 per sq. ft.; for lining the shell section adjacent to bottom head (80.1 sq. ft.) $4.23 per sq. ft. Average total cost per sq. ft. $4.93. Average cost per sq. ft. per year, based on estimated life of 15 years for stainless steel linings $0.33.

Savings with stainless steel linings as compared with carbon steel linings were given as $2.48 per sq. ft. per year, or 88.3%; as compared with gunite lining, $2.16 per sq. ft. per year, or 86.7%.

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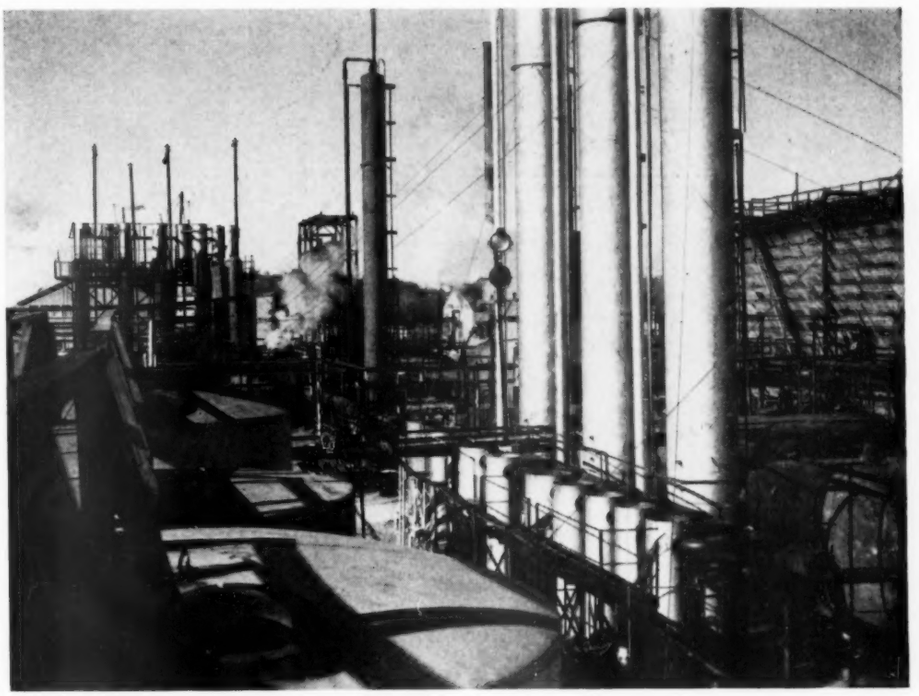
Chemical Utilization of Natural Gas and Natural Gasoline Hydrocarbons by Oxidation*

By Hooper Linford**

Further evidence is given in the accompanying article of the commercial possibilities that exist for oil companies in the derivation of valuable chemical and other products from the hydrocarbons present in the vast supplies of natural gas and natural gasoline produced in this country. Present yields of butane, propane and pentane secured from natural gasoline are shown to be only a small proportion of the volume of those and other source materials available by submitting dry natural gas to processing.

Recent experimental work which has been done in the recovery of the chemical derivatives by oxidation of the paraffin hydrocarbons from methane to octane is reviewed to show the possibilities that exist in this one type of processing. While other synthesizing processes are recognized as practical, oxidation processes are said to be of particular interest from a commercial standpoint because air can be used as the oxidizing agent and the reactions can be carried out at temperatures and pressures lower than those required in many industrial processes. Yields are given of the products of oxidation of some hydrocarbon fractions. The difficulties of controlling the oxidation reaction at the desired intermediate point are recognized and some methods for controlling the reaction are summarized.



Chemical plant of the Cities Service Oil Co. at Tallant, Okla., for the conversion by the direct oxidation of natural gas hydro carbons into formaldehyde, methanol and related chemicals. The methanol, acetaldehyde and solvent fractionating and rectifying columns are shown
(Reference in text is on page R-19)

NATURAL gas and natural gasoline are composed primarily of mixtures of the simpler or lower molecular weight paraffin hydrocarbons. Although the paraffins were originally thought to be inert chemically, they are actually chemically active and are readily converted into various widely different chemical derivatives. Moreover, the huge supplies and low values of both of these commodities make them particularly suitable as basic raw materials for the manufacture of organic chemicals. Although there are several general processes being used to synthesize organic chemicals from hydrocarbons, the object of this paper is to point out some of the potentialities of processes involving oxidation.

Natural Gas

Natural gas consists primarily of methane, but usually contains ethane, propane, and higher molecular weight paraffin hydrocarbons in decreasing proportions, together with small percentages of nitrogen, carbon dioxide and occasionally helium. The greater part of the natural gas produced in the U. S. is treated for the removal of natural gasoline and the dry gas used is a fuel for both domestic and commercial purposes, although until recently enormous quantities of natural gas have been burned or vented to the atmosphere.

According to figures presented by the Bureau of Mines[1] the estimated production of natural gas in the U. S. in 1939 was 3,333,500,000,000 cu. ft. Of this amount 2,476,756,000,000 cu. ft., or about 74% was marketed; 856,744,000,000 cu. ft., or 26%, presumably being used in the oil fields for pressuring wells, etc. or wasted. Roughly, 15% of the marketed gas was used in the production of carbon black and 85% used as fuel. The average value for natural gas in the U. S. in 1939 was 4.9c per 1000 cu. ft.

Some interesting calculations have been made to show the weight of natural gas produced in the U. S. By making broad assumptions as to its average composition it is estimated that in 1939 there was produced about 100,000,000 tons of natural gas. Assuming that all of the gas was treated for the recovery of natural gasoline there should have been produced about 9,000,000 tons of natural gasoline, including butane and propane, leaving approximately 91,000,000 tons of the dry gas. This is obviously a rich raw-material source and justifies investigation of its possible chemical utilization.

Stabilized natural gasoline is usually considered to consist of a mixture of the saturated paraffin hydrocarbons from the butanes to the octanes (C_4 to C_8) although it is usually found to contain small proportions of some of the higher molecular weight paraffins. The composition of natural gasoline varies with the source and it is often found to contain varying small proportions of aromatic hydrocarbons such as benzene, toluene and xylene, as well as naphthene hydrocarbons such as cyclopentane and cyclohexane and their simpler derivatives. Natural gasoline is used for blending in the preparation of motor fuels where it has particular value because of its low boiling point range and its rather high knock rating and lead susceptibility.

Natural Gasoline

The total production of natural gasoline in the U. S. in 1941 amounted to 2,696,568,000 gal.[2] Although no information is available as to the average value of this commodity in 1941, it is believed that it is not far different from the average value for 1940 which was estimated to be approximately 3c per gal.[3] This gasoline had an average vapor

*Presented before 17th Annual Meeting, California Natural Gasoline Assn., Los Angeles, Nov. 6, 1942.

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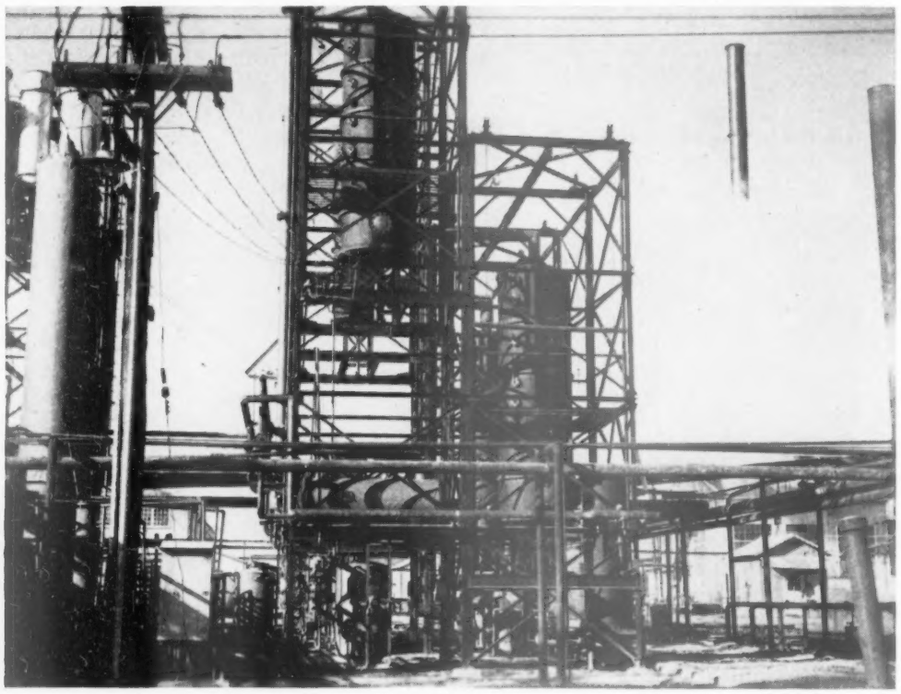
[1]Lott, F. S. and Hopkins, G. R., Minerals Yearbook, Review of 1940, Bureau of Mines, page 1029.

[2]Monthly Natural Gasoline Report No. NGR 944a—84, December, 1941, Bureau of Mines.

[3]Hopkins, G. R., and Coumbe, A. T., Natural Gasoline and Liquefied Petroleum Gases, Chapter (preprint) from Minerals Yearbook 1940, Bureau of Mines, page 1065.



Continuous columns for removing methanol and other products from formaldehyde at the Tallant plant (Reference in text is on page R-19)

pressure (Reid) of about 20 lbs. and was, therefore, a stabilized product from which propane and some of the butanes had been removed. Assuming an average weight per gal. of 5.6 lbs. for the natural gasoline, the quantity produced in 1941 was about 7,550,000 tons.

Although data are not available for the 1941 production of propane and butane, which are obtained by topping the wild natural gasoline, it has been estimated, on the basis of the 1939 production data, that there should have been produced approximately 102,000,000 gal. (249,000 tons) of propane, 92,000,000 gal. (230,000 tons) of butane and 89,000,000 gal. (220,000 tons) of a mixture of propane and butane. In addition to these 2 hydrocarbons, small amounts of a pentane fraction are produced for use as a liquid fuel. Calculations based on the 1939 production data indicate that approximately 5,000,000 gal. (13,000 tons) of this fraction were probably produced in 1941.

The above data are presented with the object of pointing out the vastness of the supply of low molecular weight hydrocarbons available in the U. S. as well as the relatively low values assigned to the products which they constitute. In this latter connection it is interesting that natural gas at 4.9c per 1000 cu. ft. is worth approximately 0.1c per lb. and that natural gasoline at 3c per gal. is worth approximately 0.5c per lb.

Chemical Utilization of Paraffin Hydrocarbons

In considering the chemical utilization of paraffin hydrocarbons 3 general types of chemical processes appear to be applicable: namely, pyrolysis, halogenation and oxidation. Commercial applications of each of these processes have been developed to a limited degree, but in no case have there full possibilities been exploited. Large petroleum chemical industries can, and undoubtedly will, be built around these basic processes in the not too distant future.

Pyrolysis

Processes in which high temperatures are used for the purpose of cracking or decomposing the hydrocarbons are referred to as pyrolytic processes. Pyrolysis of the lower hydrocarbons may result in the production of carbon, hydrogen, olefins (unsaturated hydrocarbons) and various liquid products. The latter type of compounds, resulting from the polymerization or condensation of fragments of molecules, often contain aromatic hydrocarbons in appreciable concentrations. The products of pyrolysis may be isolated and marketed as such or they may be used as raw materials for chemical synthesis. For example, the olefins produced in cracking operations may be converted into alcohols by reacting them with sulfuric acid and hydrolyzing the sulfate addition products to obtain the alcohols. Also, butadiene, a product of pyrolysis, is used in the manufacture of synthetic (Buna) rubbers.

Halogenation

The lower paraffin hydrocarbons may be treated directly with a halogen, preferably chlorine, to produce mono, di, tri, or poly halides. These halogen derivatives may be marketed directly or they may be used as chemical intermediates in the formation of many types of organic chemicals. As an example, carbon tetrachloride, which may be produced by the direct chlorination of methane, is used as a dry-cleaning fluid, an industrial solvent and as a fire extinguisher.

This compound may be converted into the refrigerant "Freon" ($C\ Cl_2F_2$) by treatment with antimony trifluoride. The mixed amyl acetates, which have a large use as lacquer solvents, are prepared by chlorinating a mixture of pentanes, hydrolyzing the chlorides to produce the alcohols, and reacting the alcohols with acetic acid to produce the esters.

Oxidation

Under controlled conditions oxygen can be made to react with the paraffin hydrocarbons to produce a large number of oxygenated derivatives which are valuable commercial chemicals. This method of chemical utilization is of particular interest from a commercial standpoint because air can be used as the oxidizing medium. Moreover, oxidation processes can often be carried out at lower temperatures and pressures than are required in many important industrial processes.

The products of oxidation include: alcohols, aldehydes, ketones, acids and esters as well as carbon monoxide and hydrogen. Although it would be impossible to list all of the uses of each of these products, some of their more important uses are discussed briefly. The alcohols are valuable solvents and chemical intermediates. Formaldehyde is used in the manufacture of synthetic resins, as will be described later. Acetaldehyde, the only other aldehyde produced in quantity by the oxidation of the lower paraffins, is used in the production of synthetic resins and also in the manufacture of acetic acid. Of the ketones, acetone is believed to be the only one produced in appreciable quantities. This compound has excellent solvent properties and is used as a lacquer solvent and also in the manufacture of smokeless powder.

Acetic acid is possibly the most important acid produced by the oxidation of paraffins and this compound is used in large quantities in the manufacture of acetate rayons as well as in the manufacture of acetate solvents. Most of the lower molecular weight acids produced, however, can be used in the manufacture of esters for use as solvents, or can be utilized as chemical intermediates. The esters produced directly by oxidation are valuable solvents. Carbon monoxide and hydrogen have been used in large quantities in the production of synthetic methanol.

Oxidation of Paraffin Hydrocarbons

Our interest lies primarily in the paraffin hydrocarbons, including the normal and iso forms, from methane to octane (C_1 to C_8) for, although other types of hydrocarbons are often present in natural gasoline, the proportion of these latter compounds is usually low.

From a theoretical, if not from a practical standpoint, it is possible to isolate, by fractional distillation processes, the lower members of the paraffin series so that it has been possible to investigate the oxidation reactions of individual hydrocarbons. A rather large amount of exploratory work has been carried out by many investigators in connection with the study of the oxidation of the lower paraffins.

Although some of this work has been of an

academic nature, most of the more recent work has had as its object the finding of conditions which will lead to the production of maximum yields of valuable chemicals, with the view to developing commercially feasible oxidation processes.

Probably the greatest obstacle to the development of oxidation processes applied to methane, or natural gas, has been the difficulty in controlling the reaction to prevent the complete combustion of the hydrocarbons to carbon dioxide and water. It is generally found, particularly with the lower hydrocarbons such as methane and ethane, that when conditions are imposed which are capable of starting the oxidation reaction, these same conditions are sufficiently severe to carry the reaction to completion. This makes it particularly difficult to isolate the intermediate oxidation products. The difficulty encountered in stopping the oxidation reaction, or series of reactions, at some intermediate point is occasioned by the fact that, in general, the partial oxidation products are more easily oxidized than the parent hydrocarbon.

Methods which have been employed for controlling the oxidation reaction are, briefly: (1) the use of small proportions of oxygen or air, i.e., low oxygen to hydrocarbon ratios, (2) the use of short reaction times followed by immediate quenching of the reaction products, and (3) the use of catalysts to direct the oxidation or to allow the reaction to take place under less severe conditions of temperature and pressure than would be required without catalysts.

A brief summary of some of the more recent experimental work which has been carried out on the lower members of the paraffin hydrocarbon series has been prepared in order to indicate the possibilities which are presented by the development of oxidation processes. No attempt has been made to include oxidation studies made with oxidizing agents other than oxygen or air and very little information is included regarding the use of catalysts. In this latter connection it can be stated that generally most of the reactions discussed in this summary can be carried out at lower temperatures and with somewhat better control by the use of catalysts.

Oxidation catalysts which have been used in the experimental work include nitrogen oxides and metals such as calcium, chromel, silver, aluminum and nickel. An effort has been made where possible to present yield data as well as to list the oxidation products for each hydrocarbon.

Methane

Methane, the simplest hydrocarbon compound, is the main constituent of natural gas. It is the most difficult to oxidize of any of the paraffins and, in this case, the intermediate oxidation products of methane are all far more susceptible to oxidation than methane. For this reason it is particularly difficult to control the oxidation reaction in such a manner that carbon dioxide and water are not the only products.

The simple theoretical reactions which occur between methane and oxygen are illustrated in Fig. 1. It is theoretically possible to produce any one or all of the compounds shown in this figure by exercising proper control of the conditions of oxidation. Padovani and Franchetti[4] found that the reaction to form carbon monoxide and hydrogen (Reaction V) takes place with good yields over a nickel catalyst at temperatures of 1560-2190°F., whereas Wiezevich and Frolich[5] found that methane reacted with air at 930°F. under a pressure of 135 atmospheres (about 2000 lbs. per sq. in.) to give methanol, formaldehyde and formic acid. At temperatures above about 930°F. the reaction tended to form carbon oxides. Operating at the lower temperature these investigators found that the ratio of production of methanol to formaldehyde was between 3 and 8 parts of the former to one of the latter, indicating that the conditions employed favored reaction (i).

Fig. 1—Reactions Between Methane and Oxygen

i.	$CH_4 + O = CH_3OH$	Methanol
ii.	$CH_4 + 2O = CH_2O + H_2O$	Formaldehyde
iii.	$CH_4 + 3O = HCO_2H + H_2O$	Formic Acid
iv.	$CH_4 + 4O = CO_2 + 2H_2O$	Carbon Dioxide
v.	$CH_4 + O = CO + 2H_2$	Carbon Monoxide and Hydogen

The work of Wiezevich and Frolich was carried out on a sample of methane containing small percentages of ethane. It was pointed out by these authors that in experiments conducted with a sample of methane containing only 0.36% of ethane slightly higher temperatures were required (970°F. or higher) to effect oxidation and most of the oxidation products were carbon oxides and water. However, small amounts of methanol, formaldehyde and formic acid were obtained.

Burke and Fryling[6] oxidized methane with 50% by volume of air at temperatures of 390° to 930°F. and pressures of 200-1750 lbs. per sq. in. without the use of catalysts and they obtained primarily aldehydes and acids. On the other hand Paris[7] found that by oxidizing methane using low oxygen to hydrocarbon ratios under high pressures the reaction leading to the formation of methanol was predominant. Although temperature did not appear to be as important as pressure in directing the reaction it was found that maximum yields of methanol were obtained at about 840°F.

It is believed that most of the experimental work carried out with methane has been done with an impure methane containing small percentages of ethane and possibly even propane and for this reason too much importance should not be placed on much of the data obtained. Partial oxidation of pure methane would undoubtedly be more difficult to control than the oxidation of methane containing even small percentages of ethane, and it is believed that further study should be given to reactions of the pure compound.

[4]Padovani, C., and Franchetti, P., Giorn. chim. ind. applicata, 15, 429 (1933); Chem. Abs., 28, 2853 (1934).

[5]Wiezevich, P. J., and Frolich, P. K., Ind. Eng. Chem., 26, 267 (1934).

[6]Burke, S. P. and Fryling, C. F., U.S.P. 1,991,344, Feb. 12, 1935; Chem. Abs., 29, 2174 (1935).

[7]Paris, A. Chimie et industrie, 31, Spec. No. 411 (1934); Chem. Abs., 28, 5806 (1934).

Ethane

The second member of the paraffin series of hydrocarbons, ethane, is appreciably more easily oxidized than methane, but still less readily attacked by oxygen than the higher members of the series. Ethane is found in natural gas in amounts varying from 0 to about 25% or even higher depending on the source of the gas.

Theoretically, the oxidation of ethane should result in the production of alcohols, aldehydes and acids corresponding to ethane and, because of the tendency for the carbon-to-carbon bond to rupture under the conditions employed for oxidation, particularly in the presence of oxygen, the same series of compounds corresponding to methane should also be expected in the reaction products. In this connection it has been found that the greater part of the partial oxidation products of ethane are ethane derivatives, i.e., they contain two carbon atoms, but appreciable quantities of oxygenated derivatives of methane are also obtained.

Newitt and Townend[8] found that ethane could be oxidized at 520°F. under 100 atmospheres pressure with the production of rather large proportions of ethanol and methanol and smaller proportions of the corresponding aldehydes and acids. Although data regarding the percentage of ethane oxidized per pass through the reaction zone are not available, recalculation of the yield data presented by these investigators indicates that by completely oxidizing 1000 cu. ft. of ethane gas (about 84.6 lbs.) they would be able to produce 103 lbs. of liquid products. Data regarding the yields of the various oxidation products of ethane are shown in Table 1.

Propane

Propane, the third member of the paraffin series, is obtained by topping or stabilizing

[8]Newitt. D. M., and Townend, D. T. A., J. Inst. Pet. Tech., 20, 252A (1934); Chem. Abs., 28, 4871 (1934).

Table 1—Products of the Partial Oxidation of Ethane

(Pressure 100 atmos.; Temperature 520°F.)

Product	Production per 1,000 cu. ft. (a) (84.6 pounds) Ethane Consumed Weight, pounds	Volume, gallons
Ethanol	52.5	8.0
Methanol	28.9	4.3
Acetaldehyde	11.4	1.7
Acetic acid	9.3	1.1
Formaldehyde	0.3	0.04
Formic acid	0.6	0.06
Total useful products	103.0	15.20

(a) Measured at 32°F. and 29.9 in. of mercury pressure.

Table 2—Products of the Partial Oxidation of Propane

(Pressure, 170 atmos.; temperature, 660°F.; conversion per pass, 5.2%)

Product	Production per 1,000 cu. ft.[a] (126 pounds) propane consumed Weight, pounds	Volume, gallons
Formaldehyde	1.3	0.2
Acetaldehyde	36.7	5.6
Acetone	12.5	1.9
Methanol	40.1	6.0
Ethanol	34.4	5.2
Propanol	29.1	4.3
Butanol	4.8	0.7
Acetic acid (containing formic acid)	11.5	1.3
Total useful products	170.4	25.2
Carbon dioxide	20.7	...
Carbon monoxide	25.4	...
Water	51.6	6.2

[a] Measured at 32°F. and 29.9 in. of mercury pressure.

natural gasoline. This compound, which is more easily oxidized than either ethane or methane, also gives rise to a greater number of oxidation products. Thus, it is theoretically possible to produce alcohols, aldehydes and acids containing 1, 2 and 3-carbon atoms, the 1 and 2-carbon atom derivatives resulting from the fission of the carbon-to-carbon bond. Also, a new type of compound is formed in propane oxidation, namely, acetone, the simplest ketone.

Wiezevich and Frolich[8] reported that by oxidizing 98% propane with pure oxygen at 170 atmospheres pressure and 660°F., without the use of a catalyst, they were able to convert approximately 5.2% of the feed per pass into oxygenated derivatives. Data presented by these investigators have been recalculated to show the yields of the various products per 1000 cu. ft. (about 126 lbs.) of propane oxidized. These data are shown in Table 2.

These investigators found that the yields of acids could be increased, at the expense of the alcohols and aldehydes, by extracting the acids from the oxidation products and recycling the intermediate oxidation products along with the propane and fresh quantities of oxygen. As might be expected the proportion of propane being oxidized to carbon dioxide and water also increased in this method of operation.

Butane

Oxidation of the butanes (normal and iso-), which are present in rather large proportions in natural gasoline, results in the production of a considerable number of oxigenated derivatives. Wiezevich and Frolich[8] report that a sample of 95% butane oxidized readily at temperatures of 410-490°F. and pressures of 33-160 atmospheres. They were able to identify alcohols containing 1, 2, 3 and 4-carbon atoms, acetaldehyde, propionaldehyde, acetone, acetic acid, and propylacetate. The latter compound is an ester resulting from the reaction between acetic acid and propanol. These investigators found that in general the lower pressures favored the formation of low molecular weight alcohols and acids, whereas the higher pressures favored the formation of higher molecular weight alcohols and aldehydes.

Bludworth[9] believes that the oxidation of butane can be controlled by a method involving many recyclings of reactants using only very small amounts of oxygen. He indicates that he is able to produce 8 gal. of liquid oxidation products from 1000 cu. ft. of butane gas by recycling 15 or 16 times. The product was found to consist of approximately 75% methanol, 12.5% acetone and 12.5% acetaldehyde.

Pentane

The products of the partial oxidation of pentanes are complex mixtures and are not readily separated into individual components. Thus, Wiezevich and Frolich[8] oxidized a mixture of pentanes consisting of 60% normal and 40% isopentane at 465°F. and 200 atmospheres pressure and obtained a series of alcohols ranging from methanol to the pentanols (containing 5 carbon atoms) together with acetaldehyde, acetone, and formic and acetic acids. It is interesting that the products were mainly in the 2 and 3-carbon atom range indicating that the pentane molecule was broken between the second and third-carbon atoms.

In a small plant operating with a flow rate of 2 gal. per minute it was found that the total liquid oxidation products amounted to 87.5 gal. per day. This plant was operated with recycling of the pentane and a pentane balance indicated that 1.7 gal. of pentane were consumed for each gallon of liquid products. Calculations have been made to show the yield of the various oxidation products for each 100 lbs. (19.2 gal.) of pentane consumed and these data are presented in Table 3.

It was found that the yields of acids could be increased by extracting the acids from the reaction products and recycling the intermediate oxidation products along with the unoxidized pentane. With this method of operation the ratio of production of formic acid to acetic acid was greatly increased. This ratio was about 1 to 11.5 when operating without recycling of the alcohols and aldehydes and when these materials were recycled the ratio was 1 to 2.7.

Hexane

There is little information available in the literature concerning the partial oxidation of hexane. Some work carried out by Wheeler and Blair[10] indicated that the slow oxidation of hexane gives higher aldehydes, unsaturates (mostly ethylene), carbon oxides and water. Increased temperatures tend to reduce the yields of aldehydes and increase the production of acetic acid. It is believed that the proportions of oxygen in the reacting mixture were higher than would be desirable for the production of high yields of alcohols and aldehydes. The high oxygen concentration may also have accounted for the rather large amounts of unsaturated hydrocarbons present in the reaction products.

[9] Bludworth, J. E., U.S.P. 1,923,610, Aug. 22, 1933; Chem. Abs., 27, 5341 (1933).

[10] Wheeler, T. S., and Blair, E. W., J. Soc. Chem. Ind., 42, 491 (1923).

Table 3—Products of the Partial Oxidation of Pentane

(Pressure, 200 atmos.; temperature, 465°F.)

Product	Production per 100 pounds (19.2 gallons) Pentane Consumed Weight, pounds	Volume, gallons
Acetaldehyde	5.3	0.8
Methyl acetone [a]	12.2	1.8
Alcohols (boiling up to 230°F.) [b]	26.8	4.0
Alcohols (boiling 230-266°F.) [c]	8.7	1.3
Acetic acid	27.0	3.1
Formic acid	2.8	0.3
Total useful products	82.8	11.3

[a] Mixture of methanol and acetone containing about 15 per cent of the former.

[b] Believed to contain ethanol, n- and isopropanols, and small amounts of tert-pentanol.

[c] Mainly secondary pentanol with small amounts of tert-pentanol.

Heptane

A mixture of the heptane isomers, obtained from casinghead gasoline, boiling between 158-207°F. was oxidized by Wiezevich and Frolich[8]. The reaction was carried out at temperatures between 356-437°F. and at pressures of 135 atmospheres. Under these conditions the heptane fraction would remain in a liquid condition so that this is truly a liquid phase rather than a vapor phase oxidation. The products were primarily alcohols in the hexyl-heptyl (C_6-C_7) range, but there were produced smaller amounts of the lower alcohols, aldehydes, ketones and acids.

Mixture of Heptanes, Octanes and Nonanes

Liquid phase oxidation of a petroleum fraction boiling in the range of 235-290°F. and consisting primarily of hydrocarbons containing 7, 8 and 9-carbon atoms per molecule, has been found to produce rather high yields of acids.[11] The stock was prepared by extracting straight-run gasoline with liquid sulfur dioxide and fractionating the portion insoluble in the sulfur dioxide (raffinate) to obtain a material of the desired boiling range. This material was found to contain approximately 51% paraffin, 47% naphthene and 2% aromatic hydrocarbons, so that the results obtained in this work are not directly comparable to those obtained with pure paraffin hydrocarbons. It is believed, however, that they might indicate the probable course of the oxidation reaction applied to a similar fraction of natural gasoline, particularly one containing naphthene hydrocarbons.

Briefly, the method of carrying out this type of liquid phase oxidation is to place the fraction to be oxidized in a reaction vessel where it is blown with air at elevated temperatures. The particular fraction referred to above was oxidized at temperatures of 300-340°F. under pressures of 100 lbs. per sq. in. Under these conditions oxidation took place readily without the use of a catalyst.

The main products of reaction were acids although appreciable quantities of alcohols, aldehydes, ketones and esters were found in the reaction products. Water and carbon

[11] Unpublished data, obtained by Union Oil Co.

Table 4 — Yields of Low Molecular Weight Fatty Acids Produced by the Liquid Phase Oxidation of C_7 to C_9 Hydrocarbons

(Pressure, 7 atmos.; temperature, 300-340°F.)

Acid	Production per 100 pounds (15.9 gallons) of Charge Consumed: Weight, pounds	Volume, gallons
Formic	9.0	0.88
Acetic	18.0	2.06
Propionic	4.5	0.54
Butyric	2.0	0.25

dioxide were always formed during the oxidation and resulted from the complete combustion of fragments of hydrocarbon molecules. It was found possible to separate the lower molecular weight fatty acids, in a relatively pure form, from the other products of reaction and the yields of these acids, per 100 lbs. (15.9 gal.) of the hydrocarbon fraction oxidized, have been calculated. These yield data are shown in Table 4.

A mixture of low molecular weight alcohols, aldehydes, ketones and esters which was readily separated from the oxidation products amounted to over 15% by weight of the hydrocarbon charge. A mixture of high molecular weight acids and esters, obtained as a residue from the oxidation vessel, amounted to about 38% of the oxidation charge. This fraction has been found to contain dibasic acids, and, in fact, appreciable quantities of pure succinic acid ($C_2H_4(COOH)_2$ have been separated from this mixture of acids by ordinary physical means.

The results of this work are of particular interest in that they show the possibility of converting a low-grade gasoline fraction into chemical products by means of a low-temperature, relatively low-pressure, oxidation process using air as the oxidizing medium.

Oxidation of Natural Gas

In the commercial utilization of oxidation as a means of producing chemicals from petroleum hydrocarbons it is probably advantageous to consider the use of mixtures of hydrocarbons rather than pure compounds due to the increased raw materials cost if separation of pure compounds were required. Narrow boiling range fractions are easily and cheaply produced in ordinary petroleum refinery equipment, and it is these fractions that are the most likely to be used in commercial oxidation processes.

Dry or lean natural gas is an example of a fraction of petroleum that can be used without further processing. This material, as has already been pointed out, contains large proportions of methane but in addition contains ethane and propane and is a material which lends itself well to chemical processing because of its huge supply and low cost.

Description of Commercial Plant

The first successful commercial plant utilizing natural gas as a raw material for the production of chemicals by oxidation is believed to be that of the Cities Service Oil Co. at Tallant, Okla. At this plant large quantities of methanol and formaldehyde are being produced, along with smaller amounts of other chemicals, by the controlled oxidation of natural gas.

The development of the oxidation process by Cities Service Oil Co. in the early part of 1928 was reported to have been the result of an investigation of a new treating procedure for natural gas designed to reduce pipeline corrosion. The corrosion was believed to have been due to the presence of small amounts of oxygen in the natural gas and in order to eliminate this oxygen additional quantities of oxygen (air) were added and the gas subjected to pressure and high temperatures in order to initiate oxidation and thus remove all of the oxygen. The oxidation products were condensed from the treated gas and found to contain methanol, formaldehyde, acetaldehyde and acetone.

The plant operations have been described briefly and a flow diagram for the operation appeared recently in the literature.[12] The operations are relatively simple and consist in compressing a mixture of natural gas and air and passing the mixture through a reaction zone at elevated temperatures. The reaction mixture is cooled on leaving the reactor and the liquid products are condensed and separated from the unoxidized gas. A portion of the gas stream from the separator is recycled, mixed with fresh feed and air, and further oxidized. The conditions of operation are not disclosed, and it is not known whether catalysts are used, but it is believed that the process is catalytic.

It is stated that the temperatures and pressures are low as compared with the temperatures and pressures required in many high pressure syntheses. Presumably, equipment cost for such installations would not be excessive. In this connection it is believed that ordinary steel equipment is all that is required since the proportion of acids in the products is very low.

Methanol and formaldehyde are the main products of this plant and these compounds are produced in approximately equal proportions. In addition to these 2 compounds there is produced an appreciable quantity of acetaldehyde and smaller amounts of acetone. In separating the reaction products, an initial rough separation is made and these impure products are refractionated to produce the materials of commercial quality. Methanol and acetaldehyde are separated as pure compounds, formaldehyde is produced as a 40% solution in water (formalin), and acetone, which is difficult to separate from mixtures containing methanol, is produced as so-called methyl acetone. This latter product is a mixture of methanol and acetone containing approximately 15% of the former and is a valuable commercial solvent.

When Cities Service Oil Co. first started producing methanol and formaldehyde there was an abundant supply of both of these products. Methanol was being produced by a high-pressure catalytic process from carbon monoxide and hydrogen, and formaldehyde was being produced by the catalytic oxidation of methanol. Although at first the production of these 2 commodities from natural gas did not appear to be justified on the basis of market conditions there shortly arose a new large utilization for the formaldehyde, and indirectly the methanol; its use in the synthetic resin industry. This new and fast growing industry was able to use all of the formaldehyde available.

The large consumption of formaldehyde by the synthetic resin industry is easily understood when it is realized that formaldehyde is used in the production of about one-half of the molded plastics manufactured in the U. S. These plastics include the phenol- and cresol-formaldehyde plastics, such as Bakelite; the urea-formaldehyde plastics such as Beetle and Plaskon; and the casein plastics, such as Ameroid. Due to the present large use of plastics in war production, there is a shortage of both formaldehyde and methanol. Formaldehyde was one of the first chemicals to be placed on a mandatory priority basis; this control being instituted in August, 1941.

The shortage of both of these chemicals has been due in part to the conversion of a large du Pont methanol plant into an ammonia plant as a war production measure. The reason for this conversion is apparent when it is realized that both the synthetic methanol process and the ammonia process require high pressure equipment that is difficult to build with the present demands on steel. It appears, therefore, that much of the formaldehyde produced to meet the war emergency will be produced at plants similar to the one at Tallant, and it is presumed that more of these plants are being, or will be constructed in the near future. It has been predicted that, even though more natural gas oxidation plants are built to meet the war demands, the natural gas process will be able to maintain its position after the war.[12] This prediction is based on the belief that the plastics industry is destined to even further expansion and to the belief that the high pressure catalytic methanol processes may find it difficult to compete with the cheaper natural gas process.

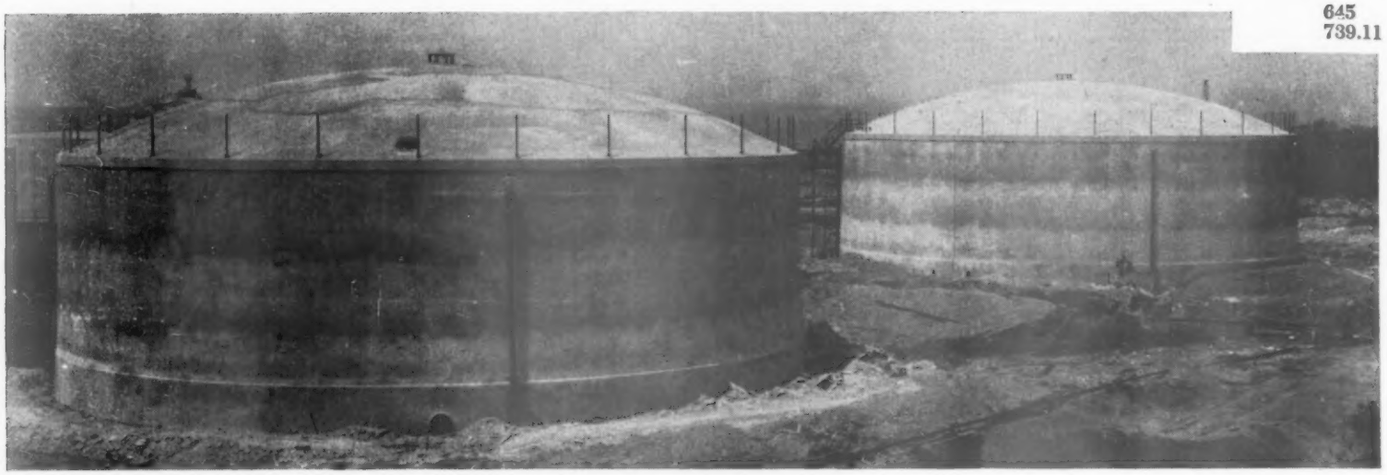
The petroleum industry has seemingly been slow to realize and to capitalize upon the fact that their basic raw materials, crude oil and natural gas, can be profitably converted into chemical products. This reluctance to enter the chemical field can be traced to several fundamental factors:

1. The industry has been so engrossed in producing huge quantities of crude oil and refining this material at a profit that consideration of chemical outlets, which at best would utilize relatively small amounts of petroleum, has not seemed desirable.

2. The costs of plants required for chemical production are, in general, far greater than the usual refinery construction costs.

3. The rapidly changing character of the chemical market makes it imperative that a manufacturer be ready to convert his plants and processes to meet the changing conditions.

[12]Chem. and Met. Engr., 49, No. 9, 154 (1942).



Concrete tanks of 100,000 bbls. capacity constructed by a new method in which the reinforcing rods are "preloaded". The tanks, said to be the largest ever built above ground, are located in Canada in fuel oil service for an oil company

100,000-Barrel Concrete Tanks for Fuel Oil Built by "Prestressing" Reinforcing Rods

ABOVE-GROUND, reinforced concrete tanks of 100,000 bbls. capacity, of a new design and method of construction, have been in service for fuel oil storage for a Canadian oil company since last February without any indication of a leak, it is reported by the engineering firm building the tanks. They are said to be the largest concrete tanks ever built to set above ground.

The tanks are approximately 132 ft. in diameter and 42 ft. high. The walls are 20 in. thick at the bottom and 4 in. at the top. The dome roof, which is also of a special type of construction, is 4 in. thick. The floor is 6 in. thick, having a special mat under the regular tank floor because of the severe climatic conditions in this part of Canada. The tanks were built last winter when the severe weather necessitated housing them entirely in frame structures so construction could be carried on.

The tanks are built by what is called the prestressed or "preload" method, by which the concrete is thrown into compression by pulling up horizontal circumferential rods in the reinforcing to a predetermined initial stress. These tanks are described as effecting war conservation of steel not only through saving the plate that would go into steel tanks of the same capacity but also because less steel is used in their reinforcing than in the ordinary reinforced concrete construction. Attention of oil companies has been called to this method of concrete construction by the materials section of the refining division of the Petroleum Administration for War.

Another special construction feature is the dome roof, which enables the elimination of supporting columns. Dome covers of this type are said to be practical up to 200 ft. in diameter. The following description of the prestressed method of concrete construction is given by the Preload Co., Inc., engineering firm with headquarters in Boston which developed this method:

"A system of reinforced concrete construction involving a different relation between steel and concrete. In the case of a tank, steel bands are tensioned around a concrete shell similarly to their use in wood stave construction. The tensioning of the bands compresses the concrete as wood staves are compressed.

"The filling of the tank elongates the shell and slightly increases the tension in the bands. The important result, however, has to do with the concrete. Instead of being tensioned in conjunction with the steel as the tank is filled it releases compression. Without tension concrete does not crack. Liquid tightness and permanence are thus accomplished. (See Fig. 1.)

"The use of special steels and extra strong concrete, each used in the proper percentage of its greater strength, results in stability and economy. Special value is gained in connection with the storage of liquids, although the principles are equally well applied to load carrying beams.

"Aside from load, the most destructive factors having to do with reinforced concrete are shrinkage and temperature. A glance at almost any conventional reinforced concrete wall or pavement will confirm this. Reinforcing steel imbedded in concrete and bonded to it resists the natural shrinkage of the concrete. Increased tensional stresses are thus set up which sometimes mount to several hundreds of pounds per sq. in., depending on the percentage of steel. If load is then applied, the additional elongation mounts to a point beyond the elastic limits of the concrete and fracture is the result."

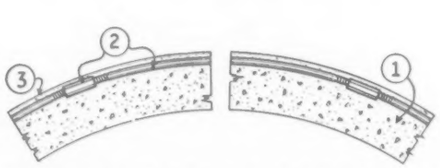


Fig. 1—Illustrating the method of "preloading" the reinforcing rods: 1, concrete wall; 2, "preloaded" rods with nuts by means of which tension is applied; 3 coat over reinforcing

The "preloading" method of construction is also applied vertically to prevent horizontal cracking which would occur due to temperature differences and shrinkage. For the storage of chemicals of high temperature or acid content, the design includes a combination concrete and tile wall. The tile inner surface is made a monolithic part of the wall and is "preloaded". The joints between the tile are filled with a special acid-proof cement having a strength equal to that of the tile.

"Preloading" maintains this joint in compression, thus preventing the possibility of cracks. The permanence of the lining is said to be that of the tile, since the joint material is more highly acid-resistant and there are no cracks through which the chemical can penetrate to the concrete in the wall.

In this method of building concrete tanks the concrete is applied by compressed air and is a mix of cement and sand with no large aggregate. It is termed by the engineers "pneumatic mortar". There is no special lining on the interior walls or floor. Tests are now under way to determine if this type of concrete construction will give satisfactory service for gasoline or other light oil storage, as well as for fuel oil. Cost of the concrete tanks is said to be about in line with steel at today's prices for tanks for the same service.

Research finds the way

Every gallon of gasoline that goes into the tank of an American fighting plane contains a precious ingredient that could not have been produced except for the curiosity, the persistence, the genius of American research men

It's made by combining olefinic with paraffinic hydrocarbon molecules Chemistry textbooks for generations had taught that such a reaction was impossible and chemists generally accepted that belief

But not Universal research men They were curious They took down the forbidding sign "It can't be done" and went ahead

They found it *can* be done, discovered the best catalysts to do it and developed processes to produce alkylate in great volume — largely increasing the possible yield of 100-octane gasoline

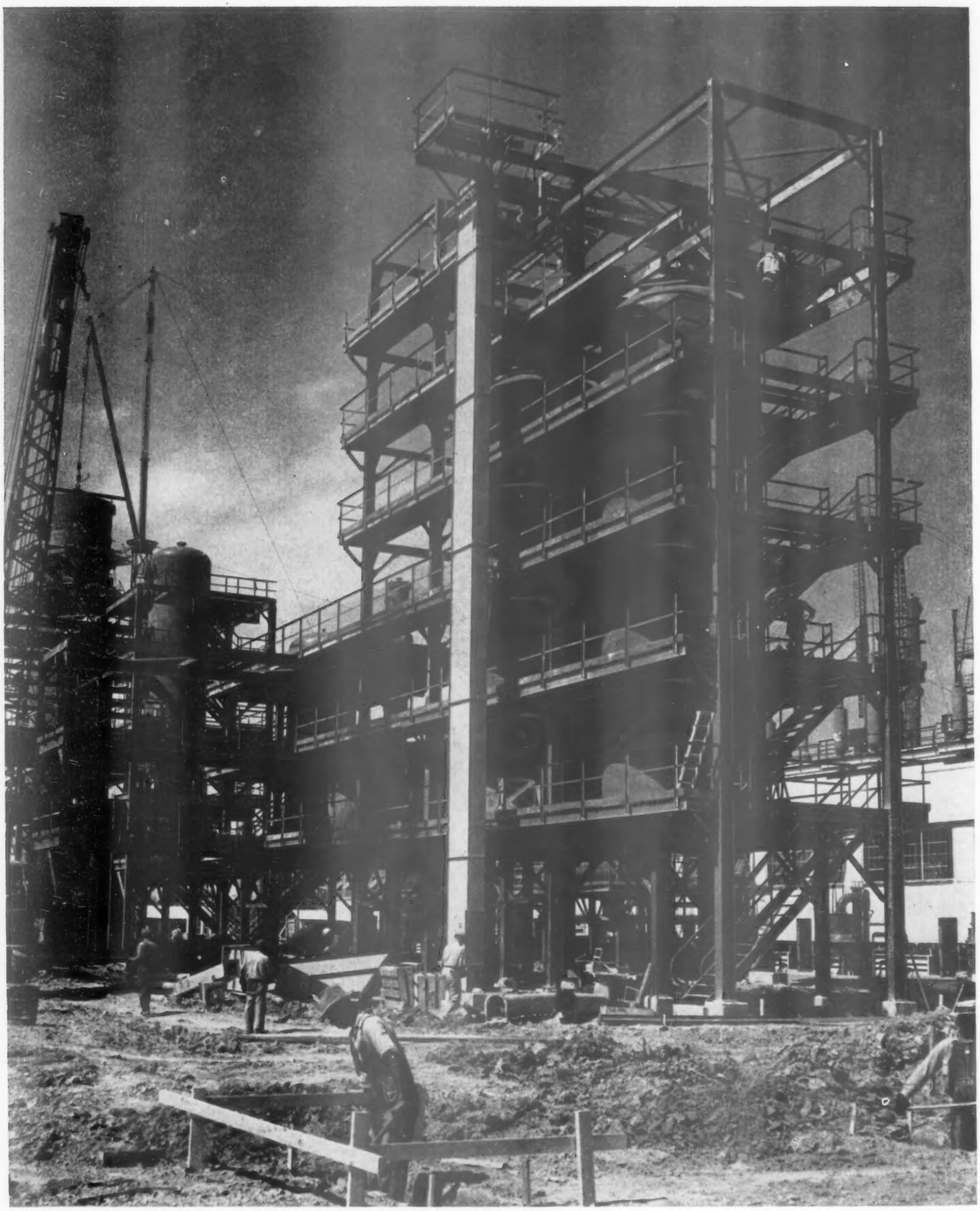
Plentiful supplies of this super gasoline give our flyers a big advantage over the enemy — thanks to the men who didn't believe it couldn't be done

OIL IS AMMUNITION — USE IT WISELY

Universal Oil Products Co
Chicago, Illinois

Dubbs Cracking Process
Owner and Licensor

THE REFINERS INSTITUTE OF PETROLEUM TECHNOLOGY



Section of butadiene plant under construction by oil company, showing some of the massive equipment required for the manufacture of this component of synthetic rubber. Plants such as this are going up all over the country to produce butadiene from mixtures of butane and/or butylenes by catalytic removal of hydrogen at temperatures ranging from approximately 900° to 1200° F. Because of a volume increase during reaction, accounted for by simultaneous production of butadiene and hydrogen, these plants will operate generally at atmospheric pressure or under vacuum (Standard Oil Co. of New Jersey)

ABC of CHEMICAL DERIVATIVES from PETROLEUM

II. Synthetic Rubbers

★

By R. L. Wakeman[1] and B. H. Weil[2]

SEVENTY thousand rubber seeds —precious cargo steaming down the Amazon and out to sea! There, in the hold of a weather-beaten freighter, lay the origin of today's vast rubber plantations. From this shipment, sent to London in 1876, some 4% germinated, yielding the first cultivated rubber seedlings, which were subsequently transported to Ceylon.

With the recent fall of Singapore and the loss of the Dutch East Indies, 92% of the world's normal rubber supply, formerly produced on Far Eastern plantations which were descendants of these seeds, slipped from British and Dutch hands into those of the enemy, confronting the United Nations with the vital necessity of immediately producing huge amounts of synthetic rubbers where almost none had been made before. The output of these synthetics in 1940 was a puny 4000 long tons. In 1943 it is expected to exceed 400,000 tons, with over a million the goal for 1944!

This subject is of such personal importance to every American that science seems to have run over the edge of the test tube and spilled into the home, carrying with it such words as butadiene, styrene, "Buna S", neoprene, "Thiokol", and "Butyl". And our "scientific-minded" newspapers have been quick to proclaim innu-

[1] Pittsburgh Equitable Meter Co.'s Industrial Fellowship, Mellon Institute, Pittsburgh.

[2] Chemistry Division, Gulf Research and Development Co., Pittsburgh.

Butadiene from Petroleum is Best Approach to Synthetic Rubber

THIS CURRENT ARTICLE. . . Why the nation has turned to the oil industry to supply the principal raw materials for a substitute for natural rubber is developed from the scientist's point of view in the accompanying article, the second in the exclusive series in NPN's Technical Section on "The ABC of Chemical Derivatives from Petroleum".

This article starts with the chemistry of natural and synthetic rubber. It gives the chemical composition of different types of the synthetic product, whether they start from petroleum or other materials. It describes briefly how synthetic rubbers are produced and tells the volume of the various kinds that are anticipated in the tremendous program to provide a substitute for the natural product for both military and civilian needs. The properties and commercial applications for the various kinds of synthetic rubber are also given.

Oil men confused by the flood of material published on synthetic rubber will find in this single article the basic facts to give them the proper perspective on the relation of the oil industry to this important wartime problem of our country.

Synthetic rubber is only one of the many new products to be supplied in the future from the conversion of petroleum derivatives by new methods and processes in petroleum refining now known to be commercially practicable. Other such products include plastics and synthetic resins, chemicals, solvents, explosives, vital in our war effort and essential in the peacetime to come.

THE SERIES, "ABC of Chemical Derivatives from Petroleum" will include 6 scheduled articles and probably others, for the developments in this new field in the oil industry are rapid and the need for information concerning them is great. The first article in the series, "Synthetic Resins and Plastics" appeared in the Nov. 25 Technical Section. Others to be published include: "Textile Fibers and Finishing Agents", "Solvents and Plasticizers", "Detergents and Synthetic Lubricants", and "Determining the Individual Oil Company's Participation in the Chemicals-from-Petroleum Industry".

THE AUTHORS. . . Both authors of these articles are now engaged in research work in this new development of the petroleum refining industry and thus their writing is on the basis of the latest available information on the subject.

Dr. Reginald L. Wakeman has done special investigation work in this field for the last 5 years at Mellon Institute of Industrial Research, where he holds an industrial fellowship. He also has had experience in the development of chemicals from the higher paraffins while with a chemical concern in this country, and earlier did research work in Europe in the chemistry of hydrocarbons.

B. H. Weil is now engaged in the study of the production, economics and uses of the petroleum chemical derivatives as a member of the staff of the chemistry division of Gulf Research and Development Co. His professional training, including his work for a master's degree, was in chemical engineering.

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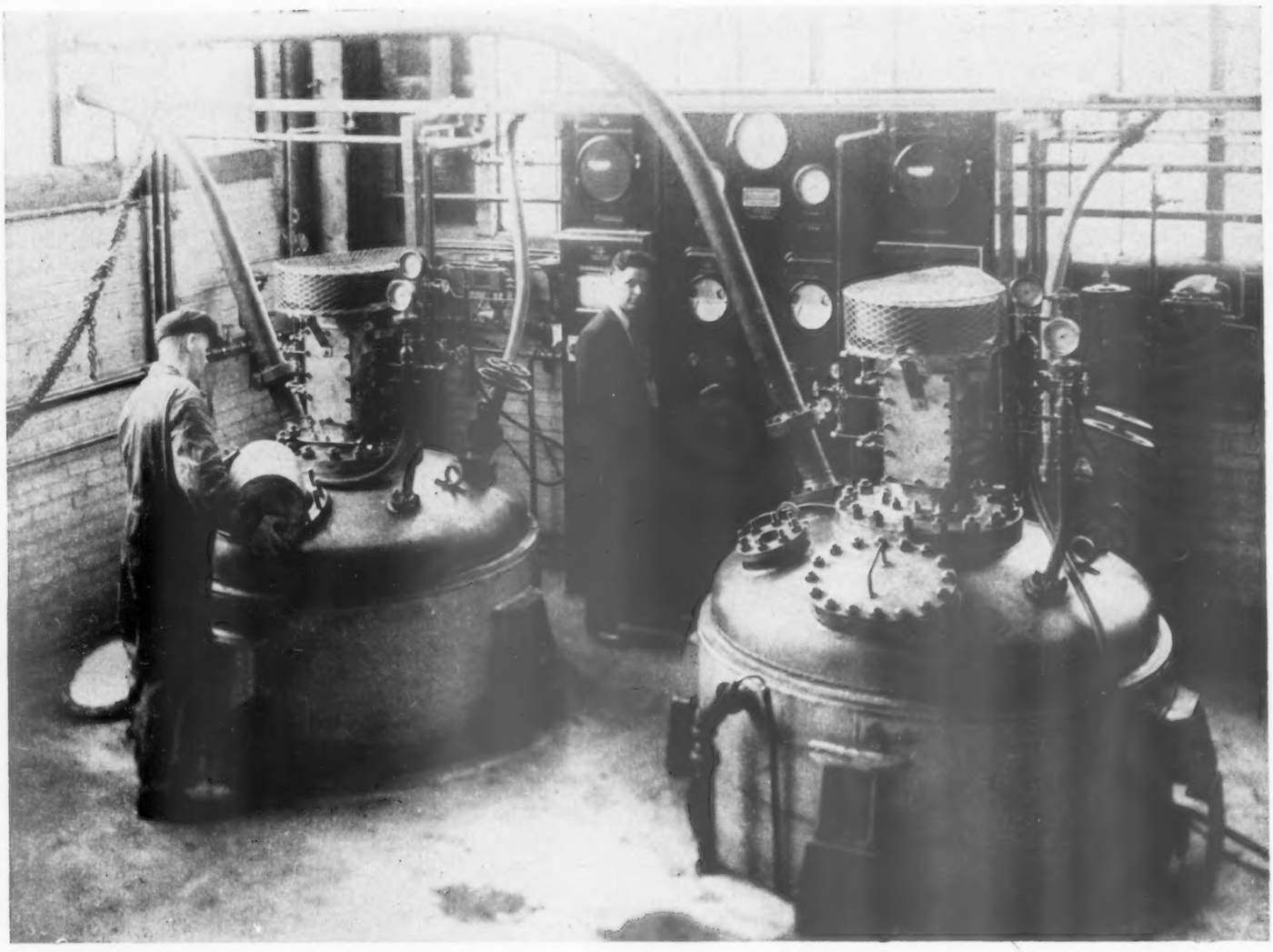
The next article in the series, "Textile Fibers and Finishing Agents", will appear in the February Technical Section, Feb. 3 issue of National Petroleum News.

R. L. Wakeman

B. H. Weil



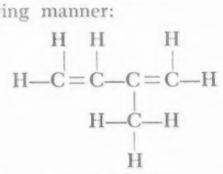
Butadiene and other ingredients which go into the production of synthetic rubber are polymerized in these large steel vessels. The butadiene and styrene are mixed at the ratio of 75:25 with about 2 times their weight of dilute soap solution. The materials react at a lukewarm temperature. A great deal of heat is evolved, hence cold water must be circulated in the jackets of the polymerizing vessels. Only mild pressures are encountered, being well under 100 lbs. p.s.i In less than a day the materials charged have reacted to form a latex containing approximately 2.5 lbs. of rubber per gal. This emulsion is about the consistency and appearance of ordinary milk. It is discharged by its own pressure through a valve at the bottom of the polymerizer. From this stage on, the coagulation, washing and drying process used in securing synthetic rubber is quite similar to that used for "tree rubber" (B. F. Goodrich Co.)

merable sources of raw materials—everything from petroleum and coal to soybeans, sunflower seed, sugar, and garbage!

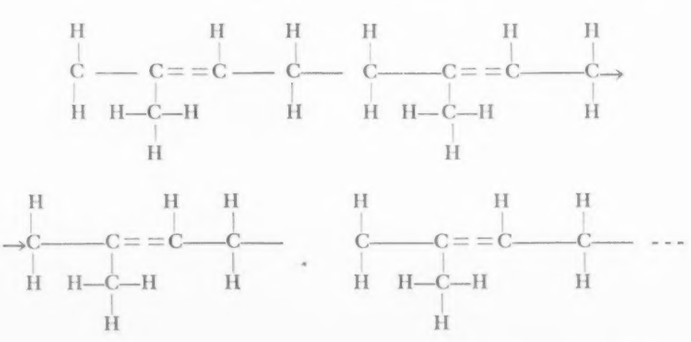
What are synthetic rubbers? To a certain extent the name is a misnomer, for, although they possess rubber-like properties, their molecular architecture is not identical with that of natural rubber.

For many years chemists were baffled by the constitution of natural rubber itself. It was known that it was unsaturated hydrocarbon[2] containing approximately 12% of hydrogen and 88% of carbon, but little else was certain, in spite of much research. Indeed, during the first World War, small amounts of an inferior rubber-like material called "Methyl Rubber" were manufactured in Germany, long before the nature of rubber itself was under stood.

Natural rubber, like synthetic resins and plastics, is composed of giant molecules. The steps performed in the laboratory of Nature in order to build up these enormous molecular edifices are not yet defined—nor is this fact surprising, for plant biologists have not ascertained with any degree of certitude the role played by rubber latex in vegetable life. Regardless of how it is produced by Nature, however, rubber is describable as a polymer of the hydrocarbon called isoprene, which possesses 5 carbon atoms and 2 double bonds united in the following manner:



A very large number of these isoprene units are joined together in a single molecule of rubber, a small portion of which is represented below.

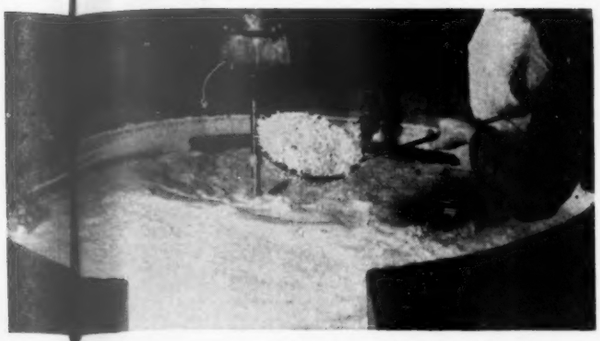


[2] For an explanation of chemical terms used in this paper, see the preceding article of this series, NATIONAL PETROLEUM NEWS, Technical Section, 34, R-412 (1942).

The total number of carbon atoms in a single rubber molecule is still a matter of doubt. The best estimates range from 7000 to 30,000, of which four-fifths are members of the principal vertebral chain. Such extremely long chains are not stiff and rigid. They kink and twist, resembling coiled springs of molecular dimensions. Hence they can be stretched out and, upon release, they fly back quickly to their "at ease" positions. Likewise they rebound if dropped upon a hard surface. These spring-like properties are imparted to rubber goods which are composed of an immensely large number of individual molecules.

Raw natural rubber has certain disadvantages which restricted its general application long after its discovery. It softens upon heating above room temperature and, upon cooling, it stiffens and becomes brittle. Moreover, its strength leaves much to be desired. For many years, Charles Goodyear sought a way to overcome these drawbacks. At length, in 1839, his patience and perseverance were rewarded by the discovery that, upon heating, sulfur could be combined with raw rubber to yield a product much less susceptible to climatic changes. This process was later called vulcanization, after the god of fire. It is now thought that, during vulcanization, bridges of sulfur atoms are established between different molecules of the rubber hydrocarbon. These bridges, in-

(*Continued on page R-28*)



From t[illegible]olymerizers comes a thick milky white liquid. Then the rubber[illegible]ent of the liquid latex is solidified in a vat by coagulating it [illegible]dilute acid. The process resembles the formation of curd in sou[illegible]. The curd is then washed by agitating it, as above, in ano[illegible]vat. This view shows a closeup of a strainer full of the rubber[illegible]icles above the swirling solution (B. F. Goodrich Co.)

Synthe[illegible]bber in one stage of the process by which petroleum refiner[illegible]es are subsequently converted into rubber. Here the rubber[illegible] emerged from the dryer and will be carried on a belt to a m[illegible] machine to be made into sheet form (Standard Oil Co. of New Jersey)

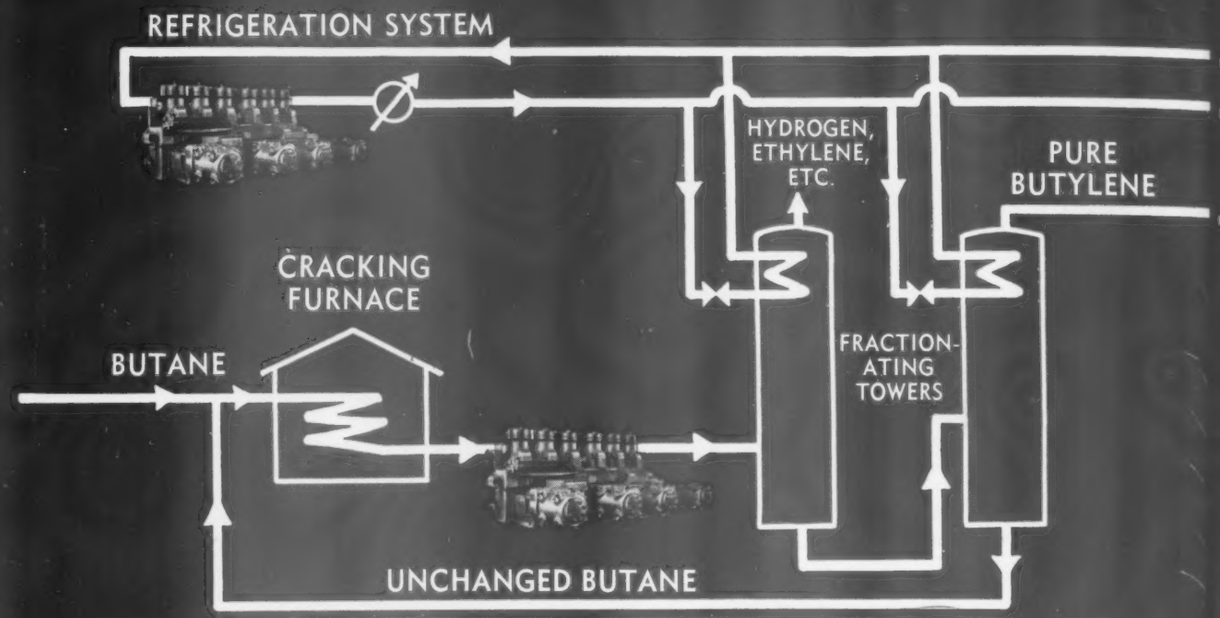
Final [illegible]g operation on Neoprene type of synthetic rubber (E. I. du Pont de Nemours & Co.)

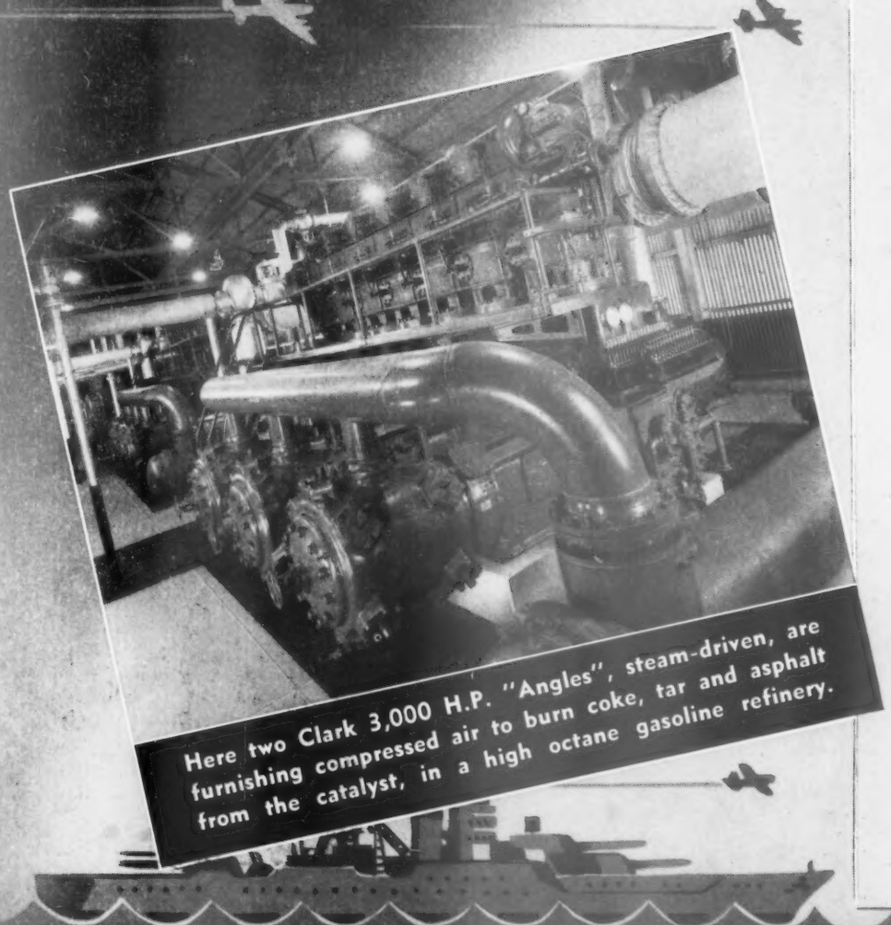
ABOVE—Loading a self-sealing gas tank into the wing of an American bomber. This fuel bladder is made from an inner layer of "Thiokol" latex, a middle layer of natural rubber and an outer layer of "Thiokol" impregnated fabric. Similar cells are being used to transform box cars into oil carriers (Thiokol Corp.)

RIGHT—This tire retreaded with "Thiokol" synthetic rubber has been driven 8500 miles and the tread is still serviceable. The road test covered a wide range of temperatures and driving conditions, but speed was kept to 40 m.p.h. (Thiokol Corp)

LEFT—Stacks of sheets of synthetic rubber like this are merely a trickle compared with the flood of synthetic rubber expected in 1943 upon completion of government-financed plants now in various stages of planning and construction (Goodyear Tire & Rubber Co.)

CLARK COMPRESS





Here two Clark 3,000 H.P. "Angles", steam-driven, are furnishing compressed air to burn coke, tar and asphalt from the catalyst, in a high octane gasoline refinery.

AMONG the scores of processes so far developed in making synthetic rubbers of the various types — one of the heavy volume roles will be that of the manufacture of Butadiene, the petroleum product from which the Buna N and Buna S types of rubber for automobile tires will be produced.

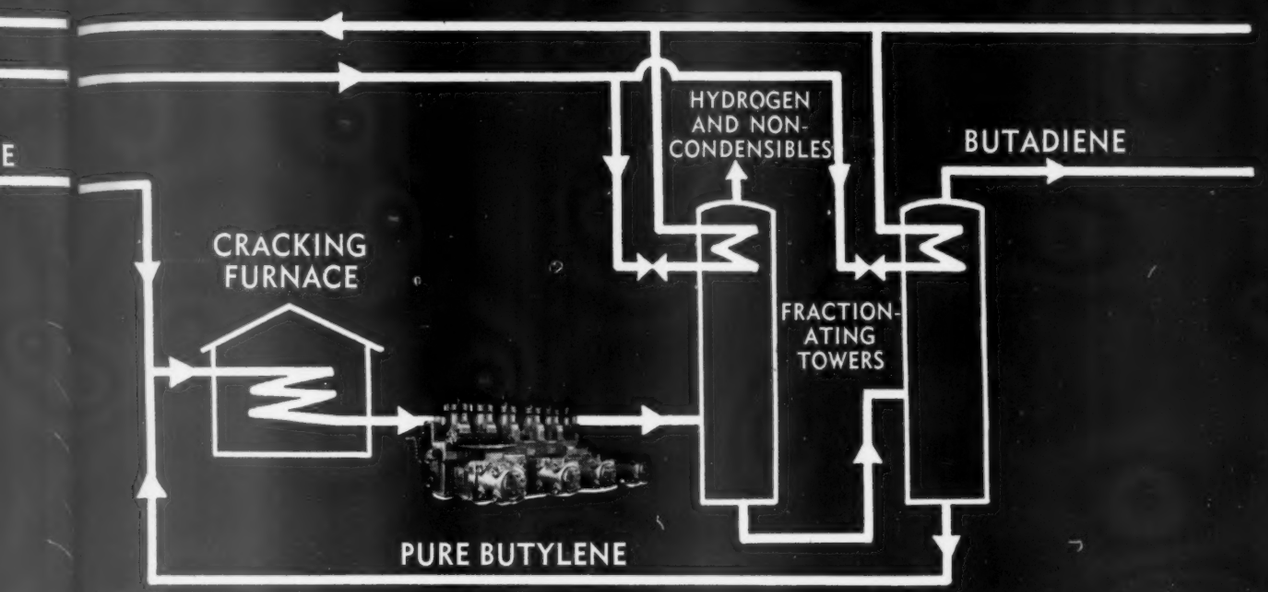
The simplified flow chart shown above indicates the part that CLARK Compressors will play in many leading Butadiene plants. They will be used for compression of gases for charging the fractionating towers and for refrigeration.

These processes are typical of the services that CLARK Compressors are being called on to perform in all types of synthetic rubber plants. In one type of plant CLARK Compressors will produce temperatures in the neighborhood of 150 degrees below zero.

CLARK Compressors are also used in the manufacture of Styrene from petroleum—the

CLA

ORS *for* BUTADIENE



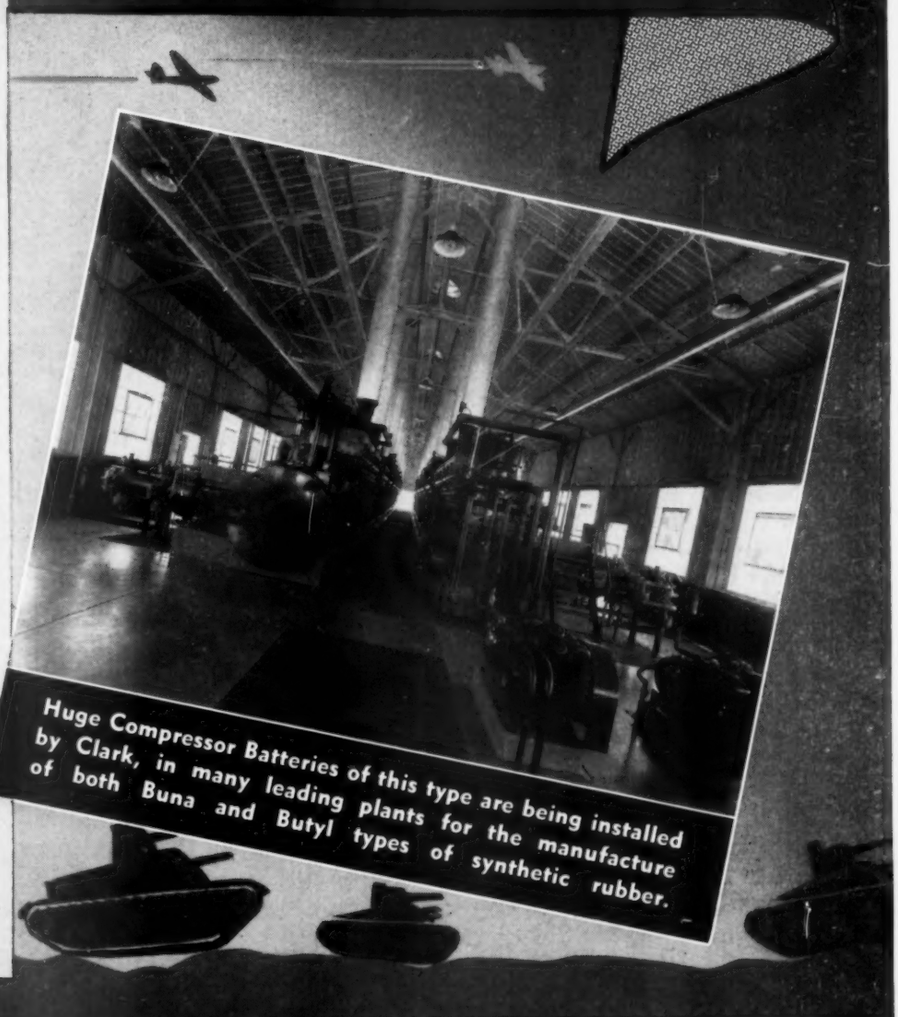
material which is combined with Butadiene to form Buna S Rubber. They are also in tremendous demand for many war industries not connected with rubber. They perform major operations in the manufacture of high octane gasoline, high explosives, synthetic alcohol, synthetic ammonia, and many other chemicals and materials needed for the war production program. Clark engineers have had intimate contact with these war industries from the start and understand their compressor problems. Call them into consultation.

CLARK BROS. CO., INC., Olean, New York

Export Offices: 30 Rockefeller Plaza, New York. Domestic Sales Offices and Warehouses: Tulsa, Okla.; Houston, Texas; Chicago, Ill. (122 S. Michigan Ave.); Boston, Mass. (131 Clarendon St.); Huntington Park, Calif. (5715 Bicket St.) Foreign Offices: 72 Turnmill St., E. C. 1, London; Avda Roque Saenz Pena 832, Buenos Aires.

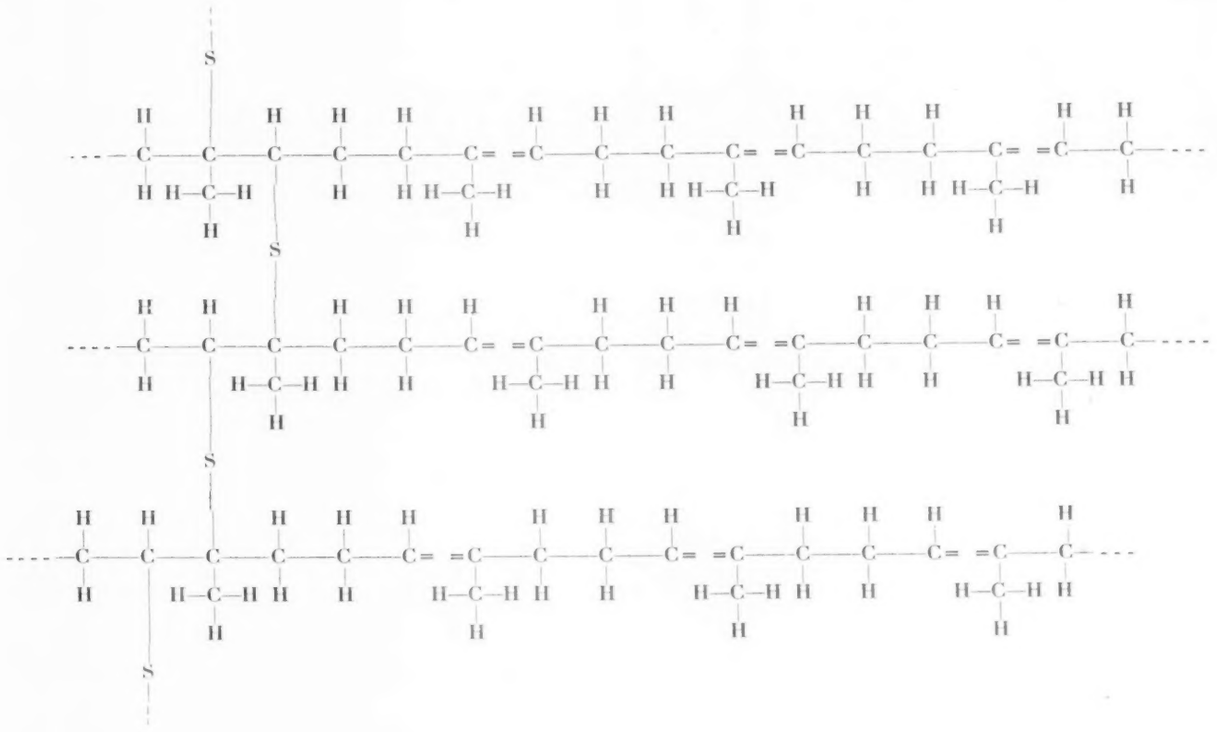
Affiliated Companies: Dresser Manufacturing Co., Bradford, Pa.; Pacific Pump Works, Huntington Park, Calif.; Bryant Heater Co., Cleveland, Ohio.

LARK



Huge Compressor Batteries of this type are being installed by Clark, in many leading plants for the manufacture of both Buna and Butyl types of synthetic rubber.

troduced at the double bonds, are illustrated below:



It is this cross-linking by means of sulfur bridges extending in all directions that lends structural re-enforcement to the giant rubber molecules, making vulcanized rubber stronger than raw rubber and less susceptible to heat. Many other compounding ingredients are mechanically combined with rubber before vulcanization—the most important of all being carbon black, which greatly increases its tensile strength—but the basic properties of vulcanized rubber, although enhanced by these other materials which are physically admixed with it, are attributable to the cross-linked molecular structures just illustrated.

In soft vulcanized rubber, only a few sulfur bridges span the gaps between the principal hydrocarbon chains. It is possible, however, to combine sulfur until all the double bonds present in the original rubber molecule have been saturated by sulfur bridges connecting either different molecules or different carbon atoms in the same molecule. Such a condition means that a very compact 3-dimensional structure now exists where only kinked linear chains were present before. Hard rubber results where the stretchability of the original molecules is thus markedly restricted and the product no longer exhibits reversible extensibility.

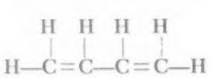
Many substances which do not have the same molecular structure as rubber, but which are also composed of extremely long molecules, possess the rubber-like qualities of stretch and bounce because of the spring-like behavior of their kinked molecules. These properties are not always apparent at room temperature; sometimes it is necessary to heat the material before they appear. Such substances are called synthetic rubbers or, better, elastomers.

Whether or not an elastomer can be vulcanized is determined by the presence or absence of reactive double bonds in its molecule. If present, vulcanization can take place; otherwise, except under unusual circumstances, it cannot.

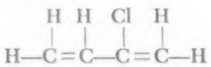
The synthetic elastomers which are of industrial importance today can be conveniently classified in the 3 groups shown in Table I. Where known, the anticipated production of these various types for 1942 to 1944 is also given.

Diolefin Elastomers

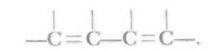
Members of the first group of elastomers listed in Table I resemble natural rubber more closely in their chemical constitution than do the others. Two diolefinic compounds, butadiene



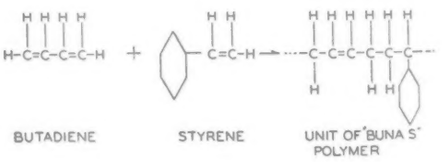
and chloroprene,



—substances which possess two double bonds, thus resembling isoprene, from which crude rubber is naturally constructed—are the primary building blocks for these rubber-like polymers and copolymers. Moreover, as in isoprene, the double bonds of these diolefins are separated by only one single bond. Their essential carbon skeleton is



First of these elastomers in national importance—as attested by an ultimate projected capacity of 845,000 long tons per year—is the butadiene-styrene type of copolymer, such as "Buna S" and "Hycar TT". In this all-purpose type of elastomer the 2 hydrocarbons—butadiene and styrene—are conjointly polymerized by mixing them in the proper proportions before bringing about reaction. The polymer is, therefore, built up by union of simple molecules of both:



The reaction is carried out industrially by emulsifying a mixture of styrene and butadiene with water, using an emulsifying agent like ammonium oleate, an ammoniacal analogue of soft soap. A catalyst[4] is then added to bring about polymerization in a closed reactor under slight pressure and at room or somewhat elevated temperatures, for example 60°C. A

[4] A catalyst is a substance used to accelerate a reaction. It does not enter into the final products formed.

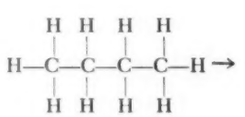
TABLE I—Anticipated Production of Synthetic Rubbers, 1942 to 1944

Type	Anticipated Production (Long Tons) 1942	1943	1944
Diolefin Elastomers*			
Butadiene-styrene copolymers (Buna S)	8,000	386,000	845,000
Butadiene-acrylonitrile copolymers (Buna N)	9,000	10,000	.....
Neoprene	12,000	30,000	69,000
Ethenoid Elastomers*			
Polyvinyl chloride†	20,000	25,000	.....
Polyvinyl alcohol†	.....	.....	.....
Polyvinyl butyral†	.....	.....	.....
"Vistanex"	.....	1,000	1,000
"Butyl rubber"	1,000	62,000	132,000
"Flexon"	.....	.....	.....
Polysulfide Elastomers			
"Thiokol"	3,000	24,000	60,000
Total production, all types	53,000	538,000	1,107,000

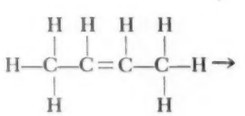
*Classified on the basis of principal monomer.
†Rubber-like plastics.

synthetic rubber latex is thus produced, similar in appearance and behavior to natural rubber latex. From this emulsion the elastomer is precipitated and coagulated by addition of acetic acid.

Butadiene from petroleum sources has, from the first, seemed the best approach to the synthetic rubber program and, on the basis of the Baruch Committee report, it now seems likely that the oil industry's two-thirds share will increase with an expanded goal. Butadiene can be produced from petroleum hydrocarbons in numerous ways. One method which will be used extensively involves catalytic dehydrogenation[5] of butane and butylenes. Butane occurs among the less volatile constituents of natural (especially wet) gas and is familiar as a component of bottled gas. Butylenes are present in refinery cracked gases and can readily be produced by dehydrogenation of butane:



Butane

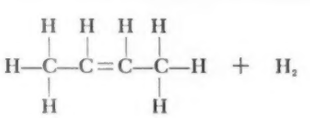


Butylene

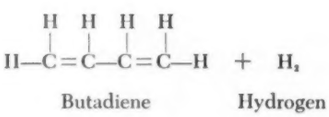
Some plants will start directly with butane and will perform the 2-step operation shown above; most will obtain butylenes from new petroleum catalytic cracking plants and will perform only the second step. Certain refiners will use the Houdry process, which accomplishes both reactions in a single operation. Pyrolysis of petroleum naphthas in thermal cracking plants, normally employed to produce gasoline, will be used as another method for making butadiene by the so-called "quick" process.

Butadiene can also be produced from petroleum hydrocarbons by a number of other chemical processes which utilize intermediates containing additional elements besides carbon and hydrogen. The most important of these procedures uses alcohol as charging stock in a reaction which may involve the formation of intermediate products not shown in the following over-all equation:

$$\underset{\text{Ethyl Alcohol}}{2CH_3—CH_2(OH)} \rightarrow \underset{\text{Butadiene}}{CH_2=CH—CH=CH_2} + \underset{\text{Water}}{2H_2O} + \underset{\text{Hydrogen}}{H_2}$$



Butylene Hydrogen



Butadiene Hydrogen

Originally it was intended to produce the alcohol for this purpose from petroleum ethylene by catalytic addition of water:

$$\underset{\text{Ethylene}}{CH_2=CH_2} + \underset{\text{Water}}{H_2O} \rightarrow \underset{\text{Ethyl Alcohol}}{CH_3—CH_2(OH)}$$

Alcohol from any source can be used, however, and the rubber program has mushroomed to such an extent since the first plans were laid that much agricultural alcohol must now be employed.

Some butadiene has been produced from petroleum sources by addition of chlorine to butene-2 ($H_3C—CH=CH—CH_3$) followed by elimination of hydrogen chloride:

$$\underset{\text{Butene—2}}{H_3C—CH=CH—CH_3} + \underset{\text{Chlorine}}{Cl_2} \rightarrow$$

$$\rightarrow \underset{\text{2, 3—Dichlorobutane}}{H_3C—CH(Cl)—CH(Cl)—CH_3}$$

$$\underset{\text{2, 3—Dichlorobutane}}{H_3C—CH(Cl)—CH(Cl)—CH_3} \rightarrow$$

$$\rightarrow \underset{\text{Butadiene}}{H_2C=CH—CH=CH_2} + \underset{\text{Hydrogen Chloride}}{2HCl}$$

In view of the chlorine scarcity, however, increased use of this process is unlikely.

Although petroleum occupies the spotlight in the production of butadiene, other sources will also be utilized. One has already been mentioned—fermentation alcohol. Chemically, of course, it is of no importance where the alcohol for butadiene comes from; it is the same compound and reacts in the same way regardless of source. The question is, therefore, one of economics and expediency. Farm interests have been most vociferous. Although considerable amounts of fermentation alcohol will be used in the production of butadiene by the process mentioned above, many arguments have been advanced for a one-step catalytic operation developed originally in Poland. It is claimed that the latter process will yield butadiene quickly from available alcohol with minimum use of strategic construction materials. A serious doubt exists, however, as to whether the use of this method or other alcohol-charging processes would be wise if new plants to produce fermentation alcohol itself are needed. Price considerations have been thrown out for the duration; it is generally conceded that petroleum butadiene will cost less than half the figure for butadiene from agricultural alcohol. It is probable, therefore, that the latter source will have considerable difficulty in maintaining its position after the war.

Still another non-petroleum source of alcohol for butadiene has recently appeared in the form of waste sulfite liquors from paper mills. One large company has made application to WPB for priorities on necessary equipment. It is estimated that the total sulfite liquors available in the U. S. and Canada could supply 10% of the projected production of butadiene.

Many other methods of making butadiene are known; few of them, however, seem likely to be used on a large scale in the immediate future. Much developmental work has been carried out or is under way upon two radically different processes: one starting with benzene from by-product coking operations,

[5] Dehydrogenation involves removal of hydrogen from adjacent carbon atoms of an organic compound, with resultant introduction of a double bond.

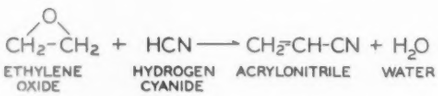
the other beginning with a butylene glycol, CH_3-CH(OH)-CH(OH)-CH_3 obtained from wheat and other cereals by a special fermentation process.

Styrene, the other "Buna S" intermediate, is most conveniently prepared from benzene and ethylene or from benzene and ethyl alcohol[6]. Of these chemicals, most of the ethylene and some of the benzene will come from petroleum sources. Another method of producing styrene has been operated for over 2 years on a pilot-plant scale. It was the outgrowth of an interesting estimate of the large amounts of styrene potentially available in the oil from carbureted water gas, and involves high-temperature pyrolysis of crude oil or petroleum fractions. Some benzene, butadiene, and other unsaturated hydrocarbons are obtained simultaneously and separated by fractional distillation.

The means whereby butadiene and styrene are copolymerized to "Buna S" and analogous elastomers have already been set forth. Predictions have been made that "Buna S" may be substituted in 90% of the applications where natural rubber was previously used. Like natural rubber, it is attacked by oils; for most applications this is not a factor. By the time that full-scale production is reached, tires made from "Buna S" will probably have been developed to the point where they will be fully as good as those from natural rubber; according to some experts, they may be considerably better.

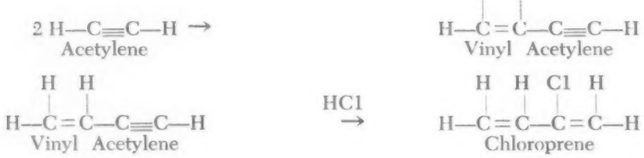
Very similar to "Buna S" is "Buna N" and its analogues such as "Perbunan", and "Hycar OR". These elastomers are also copolymers of butadiene and another unsaturated compound, usually acrylonitrile. The latter replaces styrene used in "Buna S".

Acrylonitrile is produced from ethylene by first converting the latter into an oxygen-containing compound known as ethylene oxide, which is subsequently treated with prussic acid (hydrogen cyanide):

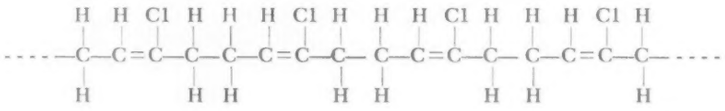


Acrylonitrile-butadiene elastomers were produced in this country before the appearance of the styrene type because, while the latter serves only as a substitute for natural rubber, the former possesses high oil-resistance and was, therefore, used even when natural rubber was available for certain mechanical applications where this property was vital.

The remaining important diolefinic synthetic elastomer is neoprene, first to be commercially developed. Neoprene is produced from acetylene, whose source in the past has been calcium carbide from coke. It should be noted, however, that petroleum is a potential source of such elastomers, for plants are under construction which will produce acetylene by pyrolysis of petroleum fractions. Neoprene is a polymer of chloroprene, obtained from acetylene as shown below:



The structure of a portion of the neoprene molecule is as follows:

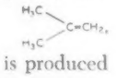


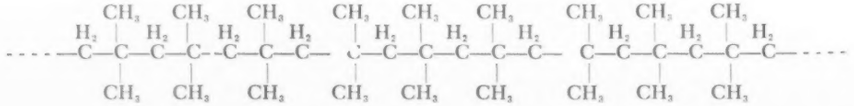
Neoprene is more resistant to both heat and oils than natural rubber and has found extetnsive industrial application because of these characteristics. Unlike natural rubber and the butadiene synthetics, it is not vulcanized with sulfur, but rather with litharge or magnesia. Moreover, it cannot be used for the manufacture of products resembling hard rubber.

Ethenoid Elastomers

Polyvinyl chloride, polyvinyl alcohol, and polyvinyl butyral, listed in Table I as ethenoid elastomers, have been discussed previously[3]. These materials are all saturated and therefore cannot be vulcanized. They require the addition of plasticizers—high boiling liquids—to make them soft and pliable. Where suitably plasticized, they exhibit plastic as well as elastic deformation and are softened by heat.

Polyvinyl chloride finds its greatest present use as cable insulation. Before the war it was utilized in belts and suspenders, coated fabric shower curtains and raincoats, alkali- and acid-resistant linings for conduits and tanks, and other mechanical applications where resistance to oils and chemicals was essential. Polyvinyl alcohol, water-sensitive but unattacked by oils, and polyvinyl butyral are also plastics which will replace appreciable quantities of rubber for special uses. The latter is now being employed in flexible tubing and in army raincoats.

Of the 3 remaining ethenoid elastomers, "Vistanex" finds specialty use where its lack of mechanical strength does not outweigh its chemical passivity. It is a completely saturated polymer of isobutylene,  , a constituent of refinery gases, and is produced by carrying out polymerization at temperatures far below zero. A portion of its structure is as follows:



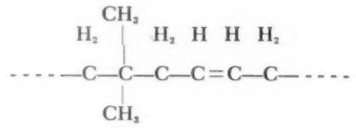
Like the other ethenoid elastomers just mentioned, its lack of double bonds makes it unreactive with sulfur, hence it cannot be vulcanized. "Vistanex" is oil-soluble and softens upon heating. It is ued as a rubber extender and for a variety of special purposes.

The double bonds present in natural rubber and in some of the diolefinic synthetic elastomers, especially "Buna S", permit vulcanization, but also cause certain disadvantages. Vulcanization uses up only 2 or 3% of all the hungry double bonds which natural rubber possesses; the remaining ones are always there, ready and eager to react with many substances such as atmospheric oxygen. This fact explains why rubber gloves stiffen and rot, why rubber tires crack and wear from "old age", and why rubber articles disintegrate upon contact with such corrosive chemicals as nitric acid. Rubber chemists have worked miracles by adding various antioxidants and other chemicals to retard many of these reactions, but they have performed even greater magic through the creation of certain synthetic rubbers which do not have these faults. Neoprene, for example, although closely related to rubber in structure, is resistant to attack by oxygen and many chemicals which would destroy natural rubber's usefulness. Its improved properties are attributed in part to its chlorine content. Similar properties of "Perbunan" and "Hycar OR" are traceable to nitrogen.

"Vistanex" is far more resistant to oxidation and attack by corrosive chemicals than natural rubber, by reason of its saturation, but it lacks the ability to be strengthened by vulcanization. Why not then copolymerize a small amount of a diolefin with the isobutylene used in making "Vistanex"? A diolefin could be used in just sufficient amount to inject enough double bonds for vulcanization, leaving the final rubber saturated after reaction with sulfur, therefore less reactive with oxygen and other chemicals. The result of such logical molecular engineering is "Butyl rubber", an

[6] This operation has been described in the preceding article of this series, NATIONAL PETROLEUM NEWS, Technical Section 34, R-412 (1942).

elastomer which, although still an infant, is according to report already half as good as rubber in tires, half as expensive to produce on a large scale as other elastomers, and less expensive even than the 1930-1940 average for natural rubber itself. The hydrocarbon mixture used in making "Butyl rubber" is composed of some 3% of butadiene or isoprene, the remainder being isobutylene. A portion of its structure is as follows:

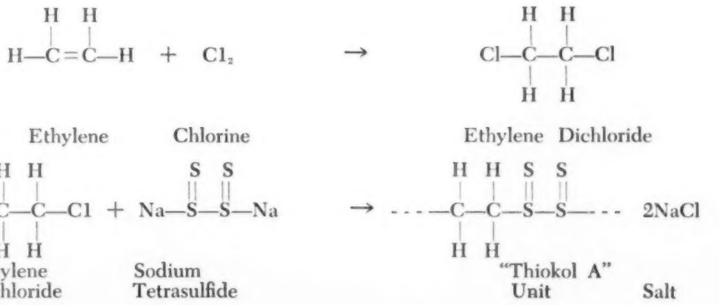


"Butyl rubber" lacks the bounce of rubber at room temperature, curiously enough. It will undoubtedly find extensive use, probably in civilian tires and possibly also for inner tubes, although it has not yet been shown completely satisfactory for the latter purpose.

"Flexon", similar to "Butyl rubber", has been referred to as "bathtub Butyl", because its production does not involve elaborate refrigeration equipment built of essential materials, but may instead be carried out in simple apparatus by use of dry ice. "Flexon" is not as good as "Butyl", nor yet as uniform in quality. Unfortunately it is wasteful of critical raw materials, a fact which may outbalance the possibility of quick, large-scale production which once led to glowing claims for its future use in tires and retreads for civilian distribution.

Polysulfide Elastomers

Last of the present important elastomers to be considered here are the polysulfides, known under the trade-name, "Thiokol". Long in use in comparative small volume for specialty purposes because of remarkable chemical and oil resistance—greater than that of any other vulcanizable elastomer—"Thiokol", or more specifically "Thiokol N", a new type, will be produced in large quantities for civilian tires and retreads. While inferior to rubber—retread mileages approximate 5000 miles at speeds below 35 m.p.h.—"Thiokol" has been acclaimed as the best substitute for non-military purposes, because its basic raw materials are readily available: refinery gas, salt, and sulfur. The exact composition of "Thiokol N" has not been disclosed, but the general type, "Thiokol A", is produced from ethylene by reaction first with chlorine and subsequently with sodium tetrasulfide:



When "Thiokol" first came on the market it possessed a malodor which made its processing difficult and which militated against its general acceptance in finished articles. This difficulty has since been partly overcome. Anyway, who cares so much about the smell of rubber substitutes these days! Several grades of "Thiokol" are now available, differing in the nature of the dichloride from which they are derived. All of them utilize constituents of refinery gas as raw materials.

In recent years, "Thiokol" has been widely used in special oil-resisting applications, among which one of the most important has been tubing and hose of all sizes for conveying gasoline and fuel oil, including automobile lines and connections, service station hose, and huge conduits for pumping fuel oil aboard sea-going vessels. Certain types of bullet-proof gasoline tanks for airplanes are made in part of "Thiokol". One of the most interesting and potentially most important applications of "Thiokol" is the current development of very large collapsible containers for transporting oil by rail. Each container holds over 2000 gals., and six of them can be installed in a box car, transforming it into a tank car having a greater capacity than the average cylindrical car. After emptying at their destination, these containers can be removed, folded up, and returned for reuse. This development is an expansion of the "Mareng cell", pioneered for airplane gas tanks.

Other synthetic rubbers can be made in countless numbers. Some of them, perhaps as yet undiscovered, will undoubtedly rival or, in the future, replace several of those now destined to see service during the current war. As with plastics, the molecular engineer will continue to fashion new elastomeric structures and then transform his conceptions into reality.

The chemist's foresight in developing so many different synthetic rubbers and so many different ways of producing raw materials for their manufacture has caused confusion even in technical circles. But the program as set forth by WPB, amended by Baruch Committee recommendations, and directed by Rubber Administrator W. M. Jeffers, is expected to provide sufficient rubber for the United Nations' military needs and for basic civilian requirements. In the development of this program petroleum will play a major role.

NEW BOOKS

Role in War of Synthetic Chemicals is Recognized

The increasing attention being given to the processing of chemical derivatives from petroleum bases by synthesis will stimulate interest of technologists and others in the oil industry in the revised fourth edition of "Industrial Chemistry", by Professor Emil Raymond Riegel of the University of Buffalo and a number of collaborators. The sections on the reactions by which numerous of these new synthetic products are secured, from petroleum and other sources, have been expanded and brought up to date, in the light of their importance in supplying materials for the nation's war program.

Regarding the chapter on petroleum and its products, the preface states: "The several innovations in the technology of petroleum called for much space, so that clear and sufficient statements on aviation gasoline, on alkylation, on the Houdry catalytic process and other topics could be made. The bottleneck on our TNT manufacture will not again be toluene, thanks in part to the process of hydroforming petroleum fractions."

"Industrial Chemistry", fourth edition, (nearly 850 pages with numerous illustrations) can be bought through Book Department, National Petroleum News, Cleveland, O., at the list price of $5.50, postpaid within the U. S.

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Valuable Reference Data In Paint Dictionary

"The National Paint Dictionary", by J. R. Stewart, has been revised to keep pace with the new materials and methods developed in the paint industry. It is intended as a handy reference volume for chemists, production managers, purchasing agents, formulators, technologists and all those engaged directly or indirectly with the manufacture, distribution, and industrial consumption or application of paint and allied products.

The book lists with appropriate explanation, the names of pigments, drying agents, essential oils and chemicals, definitions of technical paint terms and testing instruments. It includes conversion charts, nomographs, tables of physical and chemical properties of commonly used raw materials; tables of tank capacities; data on fire extinguishing mediums; tables of solubilities and electric motor wiring diagrams. It contains approximately 200 pages of text exclusive of advertising and some 250 illustrations.

The author, Jeffery R. Stewart, editor and publisher of the National Paint Bulletin, was formerly a research chemist with the National Paint, Varnish and Lacquer Assn. and still earlier was with the du Pont company. The revised dictionary can be obtained through the Book Department, National Petroleum News, 1213 West Third St., Cleveland, at $7.50 postpaid within the U. S.

Standard Refinery Piping Practice Is Prescribed in New Code

ADVANCES in piping practice now followed by many refining, natural gasoline and pipeline companies are made standard procedure in the revised Code for Pressure Piping issued by the American Standards Assn., and sponsored also by the American Society of Mechanical Engineers. The complete code, which covers power piping, gas and air piping, oil piping, district heating piping and refrigeration piping is now available to oil companies.*

The section on oil piping is a complete revision of the 1935 tentative code which has been used as a common basic standard by oil company engineering departments and designing and construction engineers. It covers oil, oil vapor and gas lines within refineries and natural gasoline plants, and oil pipelines outside refineries.

The most important feature of the code for refinery and gasoline plant engineers and designers is the introduction of an alternate method for computing pipe wall thickness, particularly for heavier walls. For the higher pressures experienced in oil company plants it was found that the single method prescribed in the earlier code, based on the well known Barlow formula, required heavier wall thicknesses than were actually necessary.

The new alternate method, which may be used irrespective of pipe diameter and wall thickness, is based on the Lame′ formula, which is also well known to engineers. The oil industry has long used a similar formula with satisfactory results for computing wall thicknesses for pressure vessels under the API-ASME Code for Unfired Pressure Vessels.

Tables Worked Out

For the oil piping section of the code a set of tables has been worked out which gives selected values for minimum allowable stress, over a wide range of temperatures, for the pipe materials more commonly used in the oil industry. These stress values (S) are used in computing pipe wall thicknesses by both the Barlow and Lame′ formulas given in the code. (The 2 methods are described and the stress value tables given in a following article).

Another important feature of the revised code is the recognition of the advances in the technique of welding pipe joints in fabricating lines and also the development of factory made welded fittings. A chapter on welding pipe joints gives new rules for qualifications of operators and welding procedure.

Significant changes in piping which have taken place since the code was originally published in 1935 which necessitated the present revision are enumerated as follows in the introduction:

"Welded joints have assumed increasing importance, standard dimensions have been prescribed for factory-made butt-welding and socket-welding fittings and their use has become common practice, welding-end valves with welded bonnets have been developed and adopted, pressures and temperature have advanced to new high points, new material specifications and dimensional standards have been formulated and numerous other changes have taken place."

By the nature of the code and also because of the length of time it has been under preparation, it does not specifically recognize the emergency wartime conditions under which refining plants are being designed and constructed today. It is a general basic code designed to serve as a standard of reference for minimum safety requirements by equipment manufacturers, engineers, erectors, companies designing plants and others concerned with pressure piping. The temperature and pressure limitations given in the oil section, however, are high enough so that the code can be used for calculating piping requirements for new processes.

Adaptable to War Conditions

Further flexibility in the use of the code to meet emergency conditions of today arises through the fact that the material requirements are based on specifications of the American Society for Testing Materials or of the American Petroleum Institute, and in a few other instances other scientific organizations. The ASTM, the recognized organization in the country for promulgating standard specifications and methods of test for materials of all kinds, is revising its specifications for steel and other metals for piping to meet the wartime shortages of high alloy steel and other metals.

It has issued alternate specifications in many instances, where substitute materials could be acceptably used for those originally specified. More of these alternate emergency provisions will be incorporated in its specifications as committees of engineers and metallurgists can prepare them. Thus the petroleum refining industry has in the code the standard for accepted practice and reference to the currently available materials to meet its piping requirements.

Sets Standards for Safety

In each field of piping covered, the A.S.A. Code for Pressure Piping provides a standard for minimum safety requirments for:

1—Selection of suitable material and reference to standard specifications by which they may be secured.

2—Designation of proper dimensional standards for the elements comprising piping systems.

3—Design of the component parts as well as the assembled unit, including necessary supports.

4—Erection of the systems.

5—Test of the elements before erection and of the completed systems after erection.

Sections Listed

The following sections have been included in this second edition of the code:

Sect. 1—Piping Systems.

Sect. 2—Gas and Air Piping Systems.

Sect. 3—Oil Piping Systems. (The provisions of this section are described in a following article by the chairman of the subcommittee which prepared this code.)

Sect. 4—District Heating Piping Systems.

Sect. 5—Refrigeration Piping Systems. (This system was designed principally for the benefit of operators of cold storage plants and does not cover special refrigerants used by refiners.)

Sect. 6—Fabrication Details.

Sect. 7—Materials and Identification.

Section 6 is intended to provide a set of minimum requirement standards covering the fabrication of equipment constituting piping installations within the scope of this code. Chapter 1 deals with the equipment which regulates the motion of and supports the piping of these systems; chapter 2, with the fabrication of pipe joints; chapter 3, with the approved methods of providing for the thermal expansion of piping and the flexibility of piping systems; chapter 4, with the preparation of parts for welding, the making and testing of welded pipe joints and the testing of welding processes and operators; chapter 5, with the fabrication and welding of branch connections.

A. D. Sanderson, Elizabeth, N. J., Standard Oil Development Co., recently deceased, was chairman of the subcommittee on oil piping of the A.S.A. Committee on Code for Pressure Piping. He was also chairman of a subgroup on pipe wall thickness and gave a great deal of time and energy to the work up until his death early this fall. Other oil company representatives on the subcommittee on oil piping were Charles Fitzgerald, Fort Worth, assistant to the vice-president of the pipeline department, Sinclair Refining Co., and R. V. King, San Francisco, Standard Oil Co. of California.

Representatives of pipe manufacturers and fabricators on the committee were: H. E. Haller, Pittsburgh, president, National Valve & Mfg. Co.; Edward Hering, Burlington, N. J., chief engineer, U. S. Pipe & Foundry Co.; J. W. Moore, Birmingham, Ala., manager of department of engineering sales, American Cast Iron Pipe Co.; F. H. Moorhead. New York, Walworth Co.; H. R. Redington, Pittsburgh, research and metallurgy department, National Tube Co.

*The Code for Pressure Piping is published by the American Society of Mechanical Engineers, 29 W. 39th St., New York. The price is $2 and it can be bought through this society or the American Standards Assn., at the same address.

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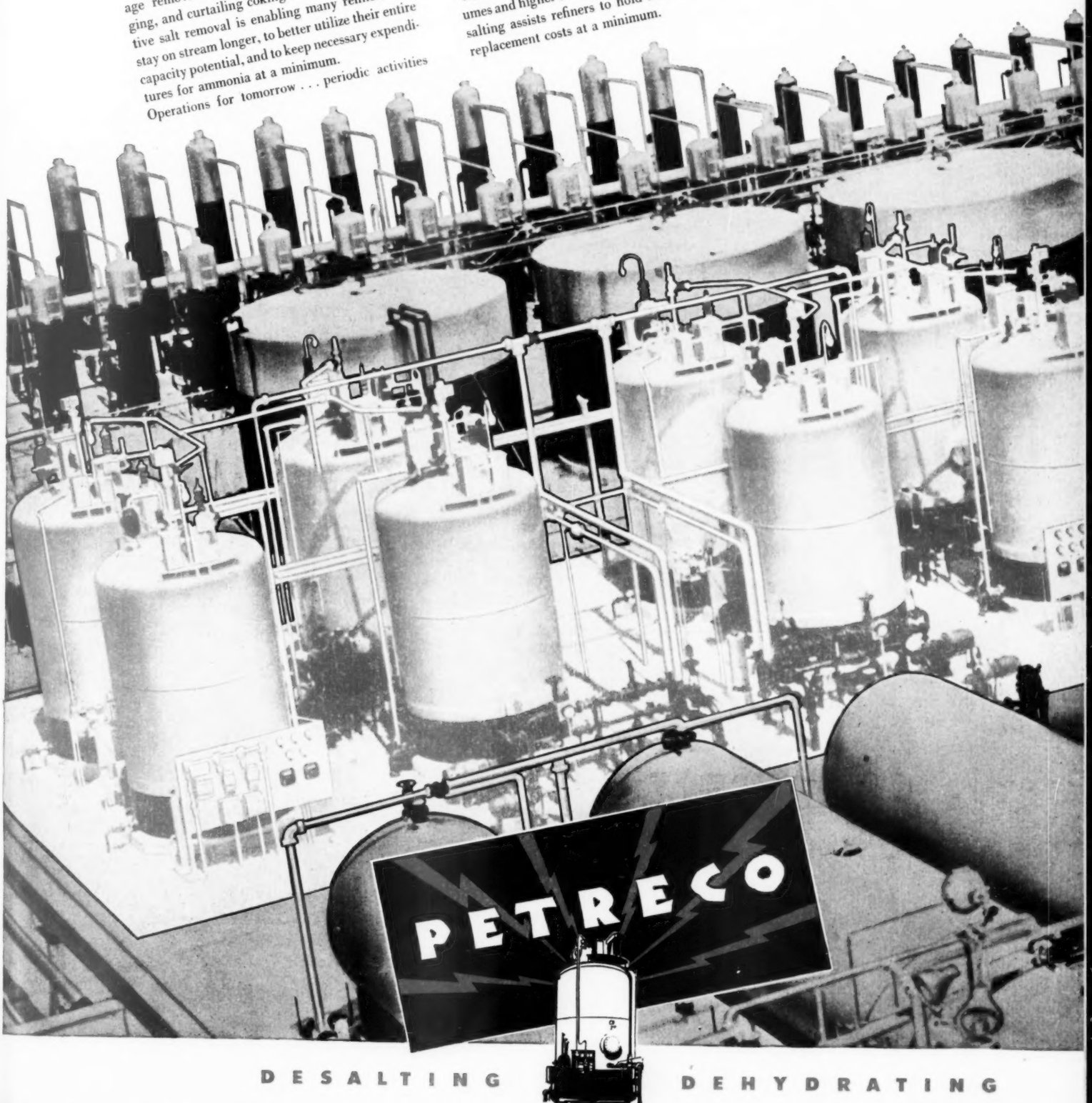


DESALTING DEHYDRATING

Application of New Piping Requirements In Refineries and Gasoline Plants

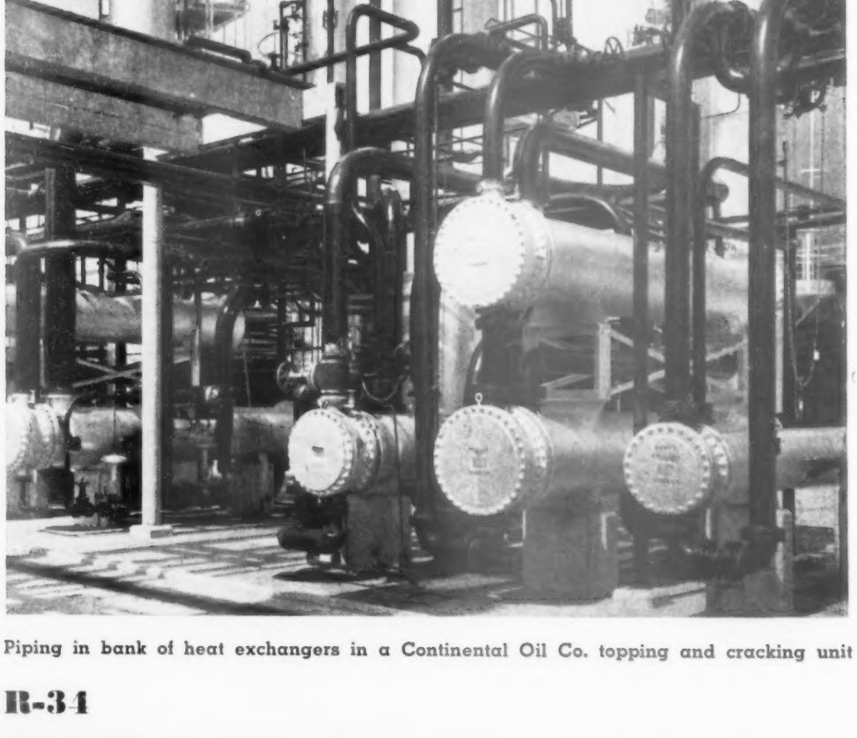
The scope of the code on Oil Piping Systems in the A.S.A. Code for Pressure Piping is defined as "covering mandatory requirements and recommended practices for the design, manufacture, test and installation of oil piping systems and the component parts of such piping including, for example, the pipe, flanges, bolting, gaskets, valves and fittings, used in the production, transmission and refining of petroleum. It is not intended to include casing, tubing, or pipe used in gas or oil wells."

Its requirements apply to oil piping, refinery gas piping and piping for natural gasoline plants. They may also be used for corresponding pressure and temperature conditions for other piping, such as steam, air, water, gas etc., but not for steam piping within the limits of the boiler plant area nor for boiler feed water piping between feed pumps and boilers.

The code requirements do not apply to heater coils, economizers or pipe exchangers, except surface coolers or exchangers ordinarily known as condenser box coils.

The oil piping includes piping, valves and fittings up to the connections of drums, pressure vessels and apparatus, and up to the tube sheets of furnaces, interstage piping between compressors or duplex pumping equipment, etc.; but does not include (1) the connections themselves, which are ordinarily furnished as a part of the equipment; (2) piping exposed to flame in furnaces; (3) internal piping or its parts integral with the equipment or apparatus.

The accompanying article describing the principal provisions of the oil code was prepared by the oil company engineer who was chairman of the subcommittee on oil piping and also of a subgroup on pipe wall thickness.



Piping in bank of heat exchangers in a Continental Oil Co. topping and cracking unit

By A. D. Sanderson*†

PIPING requirements and specifications under Section 3 of the code are understood to apply particularly to oil piping, refinery gas piping and piping for gasoline recovery plants. However, it is intended that these requirements and specifications may also be applied for the corresponding pressure and temperature conditions to all piping other than oil, such as steam, air, water, gas, etc., used in the distribution systems and process areas of plants devoted principally to the processing and handling of oils, even though some of such piping may be covered by other sections of the code.

The requirements are not intended to apply, however, to steam piping within the limits of the boiler house or boiler plant areas of such plants, nor for boiler feedwater piping between feed pumps and boilers. Piping for these services and in these locations shall conform to the requirements of section 1.

It is the intent that miscellaneous piping as covered by other sections of the code, such as refrigerating piping, shall conform to the piping requirements of the individual sections concerned insofar as practicable, but with the provision that piping as covered by section 3, for oil piping, may be used when within refinery limits.

Cast Iron Pipe and Fittings—Several new requirements for cast iron pipe have been added and provisions existing in the previous edition of the code have been clarified to cover more fully the applications of cast iron pipe for oil service.

Paragraph 306 (1) has been expanded to read as follows:

Cast iron pipe may be used for:
(1) Oil, refinery gas, brine, foamite, etc., for underground service where the temperature within the pipe is less than 300° F. No operating pressure limit is prescribed except as the pressure may be limited by the specified test pressure and by the requirements of the pipe wall thickness formula. Above ground, cast iron pipe may be used for oil or refinery gases for pressures not in excess of 150 psi, where the metal temperature does not exceed 300°F.[3].

(Paragraph 306 (2) provides that cast iron pipe may be used within refinery limits for oil condensers or coolers for a service pressure not in excess of 150 psi where the pipe is covered by water the temperature of which is not over 212°F., and where the metal temperature will not exceed 450°F. Where the piping is not immersed in water, the specifications given in the code for the particular pressures and temperatures shall apply.

Cast iron pipe, when used for gas or oil piping within refinery limits, shall be capable of withstanding a minimum hydrostatic test pressure of 3 times the service pressure for which the line is designed or under

* Deceased, formerly engineer, Standard Oil Development Co., Elizabeth, N. J.; chairman of subcommittee on oil piping of A.S.A. sectional committee on Code for Pressure Piping; chairman of subgroup on pipe wall thickness.

†Taken from a report published in the journal, *Heating, Piping and Air Conditioning.*

which it will operate, and in no case less than 300 psi, the code also provides.

Paragraph 307 provides that cast iron pipe may be used for oil piping outside of refinery limits where the temperature does not exceed 300°F. Metal thicknesses and pressure limitations at the time of installation are prescribed—Editor's note.)

Pipe Joints—The types of joints formerly permitted for cast iron pipe above ground are now specified for use either above or below ground with the special proviso that pipe lines above ground having joints which are of the packed gland type shall be suitably anchored to prevent pulling the joints apart. These requirements, as contained in the new issue, are as follows:

All cast iron pipe shall have either bolted flange connections, threaded joints, sleeve or gland couplings, or gland packed joints made integral with the pipe, or special joints such as rubber or flexible rings held tight by pressure and properly retained, or bell and spigot pipe connections.

When cast iron pipe is used above ground with joints of the packed gland type or other type offering no positive mechanical connection between the joined sections, the pipe shall be anchored in such a way as to prevent the joints pulling apart.

More liberal use of the various types of flange facings is contemplated in paragraph 318. The following types of flange facings may be used for all classes of piping, subject only to the temperature and pressure limitations given for plain facings and for the male and female facing: (1) Plain, or raised face with smooth or serrated finish, not to be used for temperatures in excess of 750° F. (2) Male and female, not to be used for pressures over 300 psi when temperatures exceed 900° F. (3) Tongue and groove. (4) Ring type. (5) Ground ball type.

Six tables have been included in the section containing pressure-temperature ratings for American standard cast and forged carbon and alloy steel valves, flanges and fittings, including pressure series from 150 to 2500 psi. Three of these tables concern the ring joint facings, whereas the remaining tables contain ratings for facings other than ring joints, all of which are given the same value. In other words, plain face, raised face, male and female, tongue and groove and the ground ball type facings are assigned the same pressure-temperature ratings, subject of course, to their limitations in use as given above. At present, welded joints are considered the equivalent of ring joints in the assignment of ratings.

To assist in determining pressure ratings for temperatures intermediate between those listed in the tables, 6 new charts have been included on which rating curves have been drawn representing the 7 pressure series covered in the American standard for steel flanged fittings and companion flanges.

Sets Standards for Joints

This issue of Section 3 also contains extensive provisions regarding permissible types of joints for nonferrous pipe and tubing which were not covered in the 1935 edition of the piping code. The new requirements are as follows:

For pressures and temperatures permitted by this code for the pipe or tubing, valves, fittings and flanges shall be attached to non-ferrous pipe or tubing by threading (when made to iron pipe size dimensions), by compression type, or flared, or flanged or lapped connections. Joints of the socket braze type also may be used for the attachment of valves, fittings and flanges to non-ferrous pipe and tubing. Such joints shall be made with brazing alloy consisting of not less than 60% copper having a melting point above 1000°F. The brazed junction between pipe and valve, fittings or flange shall extend the full depth of the socket. Fillet brazed joints are not acceptable.

Since the allowance for mechanical strength and corrosion in figuring the minimum pipe wall thickness for non-ferrous pipe and tubing has been reduced to zero in all sections of the code, it was necessary to specify certain minimum wall thicknesses for plain end, non-ferrous pipe and tubing to avoid possible use of overly thin pipe which would not be suitable from the standpoint of mechanical strength. The requirement for minimum thickness of non-ferrous pipe and tubing is as follows:

For plain end non-ferrous pipe or tubing, minimum wall thickness shall be as follows: For nominal sizes up to ¾ in., the nominal thickness shall not be less than specified for type K of A.S.T.M. specification B88; for nominal sizes ¾ in. and larger, the nominal wall thickness shall not be less than 0.049 in. Additional wall thickness should be provided as required to care for corrosion, erosion or mechanical strength.

As has been mentioned in previous articles, an alternate formula based on the Lame' formula for computing wall thickness of pipe has been added to this section. The application in the oil section differs from that in the power section in that the alternate formula may be used irrespective of diameter and wall thickness, whereas for power piping its use is limited to nominal pipe sizes 4-in. or greater, and where the minimum thickness of the pipe is equal to or greater than 10% of the inside diameter.

Allowable Stress Values—Each individual subcommittee of the sectional committee which formulated the code has selected values of allowable stress for computing pipe wall thickness according to its interpretation of the hazards involved and in relation to the material used. For oil piping within refinery limits, the allowable stress at a temperature of 650° F. is based on a factor of safety of four as applied to the tensile strength, whereas for power piping, a factor of safety of five is used. At 650° F., for example, grade A, A.S.T.M. specification A106, material is assigned an allowable stress of 12,000 psi for oil piping, but only 9600 psi for power piping. Other values for the various materials differ correspondingly.

Considers Creep Strength

At higher service temperatures, where creep of the metal is a predominant factor, the difference in practice between power and oil piping is again evident. It is customary practice in power piping to base allowable stresses at elevated temperatures on 80% of a creep strength which will result in a rate of elongation of 1% per 100,000 hr.; whereas in oil piping, at rate of 1% per 100,000 hr. is commonly used. This is reflected in the value of allowable stress of grade A, A.S.T.M. specification A106 material, which is assigned 7000 psi for oil piping, whereas for power piping, only 5600 psi is permitted.

Again, at lower service temperatures, this section of the code permits a greater increase in allowable stresses than is permitted by the power section, for instance. As explained in the January HPAC, the increase in allowable stresses at the reduced temperatures is based on increased yield strength of material as well as the reduced hazard involved in conveying the fluids at the lower temperature.

Extensive tables of new and revised allowable stresses have included in this new issue of Section 3 of the code to provide for many of the more commonly used pipe materials in the oil industry, including carbon and alloy steels, brass and copper, cast iron and wrought iron. New values of allowable stress applicable to oil piping systems used outside of refinery limits also have been included. (These stress value tables are published with the following article, which describes accepted methods for computing pipe wall thickness.)

List of Material Specifications from the Section on Oil Piping Systems of the A.S.A. Code for Pressure Piping

(Table 12 in Code)

Material	Specifications
Bolting:	
Alloy steel	A.S.T.M. A 96
Commercial steel (bar stock)	A.S.T.M. A 107
Malleable iron[3]	No Spec. available
Wrought iron (bar stock)	A.S.T.M. A 84
Alloy steel for high temperature service	A.S.T.M. A 193
Nuts, carbon and alloy steel	A.S.T.M. A 194
High strength cast iron for	No Spec. available
Fittings, Valves and Flanges:	
Bronze[1] (or brass)	A.S.T.M. B 60
Bronze[1] (or brass)	A.S.T.M. B 61
Bronze[1] (or brass)	A.S.T.M. B 62
Cast iron[2]	A.S.T.M. A 126
Malleable iron[3]	A.S.T.M. A 197
Malleable iron	A.S.T.M. A 47
Steel (cast carbon)	A.S.T.M. A 95
Steel (cast alloy) up to 1100°F.	A.S.T.M. A 157
Steel (forged alloy)	A.S.T.M. A 182
Steel (forged carbon)	A.S.T.M. A 105 or A 181, or S.A.E. 1025
Steel carbon and carbon-moly, welding fittings	A.S.T.M. A 234
Steel, cast carbon, suitable for fusion welding up to 850°F.	A.S.T.M. A 216
Steel, cast alloy, suitable for fusion welding 750° to 1100°F.	A.S.T.M. A 217
Pipe:	
Brass[4] (seamless)	A.S.T.M. B 43
Cast iron[2] (pit-cast)	A.S.T.M. A 44
Cast iron[2] (centrifugally cast or cast horizontally in green sand molds)	F.S.E.C. WW-P-421
Copper[4] (seamless)	A.S.T.M. B 42
Iron (open-hearth)	A.P.I. 5L
Steel[5] (seamless and welded)	A.P.I. 5L A.S.T.M. A 106 or A.S.T.M. A 53
Steel (electric-fusion-welded, 18 in. and larger for high press. and high temp. service)	A.S.T.M. A 155
Steel[5] (forge-welded)	A.S.T.M. A 136
Steel (carbon molybdenum)	A.S.T.M. A 206
Steel (alloy for high temperature service)	A.S.T.M. A 158
Wrought iron[6]	A.P.I. 5L
Tubing:	
Copper[4] (seamless)	A.S.T.M. B 75
Copper[4] (seamless water tube)	A.S.T.M. B 88
Copper alloys	A.S.T.M. B 111

[1] Bronze or brass fittings and valves shall not be used over 350° F., nor where fire hazard is involved. Bronze or brass trim or valves shall not be used over 400° F., nor where a fire hazard is involved.

[2] Cast iron shall not be used for any service in excess of 450° F.

[3] Malleable iron shall not be used for any service in excess of 500° F.

[4] Brass and copper tube or pipe shall not be used over 350° F.

[5] Steel pipe in accordance with A.S.T.M. Specification A 53 or A 136 is not recommended for any service in excess of 750° F.

[6] Wrought iron pipe shall not be used for any service in excess of 750° F.

New Method for Computing Pipe Wall Thickness Provided in Revised Code

The two methods for computing pipe wall thickness for piping used in pipelines, refineries and natural gasoline plants, which are introduced in the new revised Code for Oil Piping Systems of the A.S.A. Code for Pressure Piping, are described here by the engineer who was chairman of the A.S.A. subcommittee on plan and scope of the new code.

The 2 methods are included in Paragraph 325 of the code on oil piping: Method (a) referred to there being the Barlow formula described here; and method (b), the new alternate method, also described here, using the Lame′ formula added particularly for competing thickness of oil piping.

For the application of these methods in computing wall thickness in designing refinery, gasoline plant and pipeline piping installations, tables giving the minimum allowable stress value (S) used in the formulas were prepared by the subcommittee drafting the code on oil piping and are given in the oil piping section of the code. These tables are published with the accompanying article. They cover the piping materials in common use in refineries. One table also gives the minimum allowable stress values for pipe for pipeline systems outside refineries.

By Sabin Crocker*†

THE principal pipe wall thickness formula, which appears in the several code sections for the various types of piping covered, constitutes one of the fundamentals of the code.

The basic formula is:

$$t_m = \frac{PD}{2S} + C$$

where t_m = minimum pipe wall thickness in inches;
P = maximum internal service pressure in psi gage (plus water hammer allowance in case of cast iron pipe conveying liquids);
D = outside diameter of pipe, in inches;
S = allowable stress in material due to internal pressure, at the operating temperature in psi., and;
C = allowance for threading, mechanical strength, and/or corrosion, in inches.

This is the well-known Barlow formula modified by the addition of a constant C which provides an allowance for threading, mechanical strength and/or corrosion. This formula, by reason of its simplicity in application, and its proved good accuracy in predicting the burst-

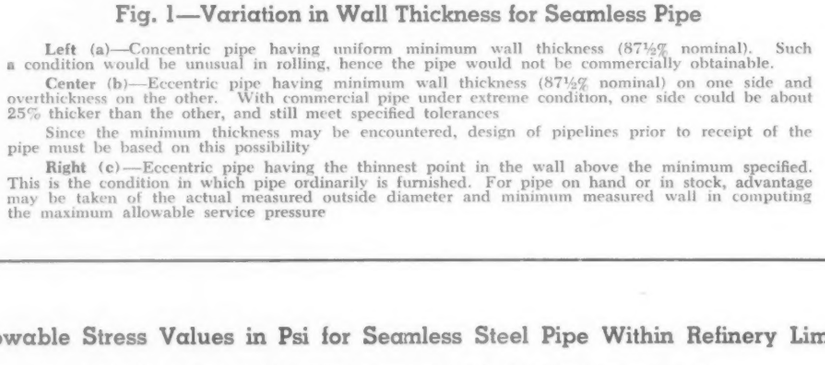


Fig. 1—Variation in Wall Thickness for Seamless Pipe

Left (a)—Concentric pipe having uniform minimum wall thickness (87½% nominal). Such a condition would be unusual in rolling, hence the pipe would not be commercially obtainable.

Center (b)—Eccentric pipe having minimum wall thickness (87½% nominal) on one side and overthickness on the other. With commercial pipe under extreme condition, one side could be about 25% thicker than the other, and still meet specified tolerances

Since the minimum thickness may be encountered, design of pipelines prior to receipt of the pipe must be based on this possibility

Right (c)—Eccentric pipe having the thinnest point in the wall above the minimum specified. This is the condition in which pipe ordinarily is furnished. For pipe on hand or in stock, advantage may be taken of the actual measured outside diameter and minimum measured wall in computing the maximum allowable service pressure

Allowable Stress Values in Psi for Seamless Steel Pipe Within Refinery Limits[1]

(Table 22 in Sect. 3, Oil Piping Systems of A.S.A. Code for Pressure Piping)

Specification	A.P.I. 5L A.S.T.M. A 106 A.S.T.M. A 53°° Grade A Tensile Strength = 48,000 psi Yield Point = 30,000 psi			A.P.I. 5L A.S.T.M. A 106° A.S.T.M. A 53°° Grade B Tensile Strength = 60,000 psi Yield Point = 35,000 psi			A.P.I. 5L Grade C Tensile Strength = 75,000 psi Yield Point = 45,000 psi		
Temperature Deg. F.	Silicon Killed[1,5]	Low Silicon Killed[2,5]	Rimmed[3]	Silicon Killed[1,5]	Low Silicon Killed[2,5]	Rimmed[3]	Silicon Killed[1,5]	Low Silicon Killed[2,5]	Rimmed[3]
100	18,000			21,000			27,000		
125	17,700			20,700			26,600		
150	17,450			20,450			26,250		
175	17,150			20,150			25,850		
200	16,900			19,900			25,500		
225	16,600			19,600			25,150		
250	16,350		Same	19,350		Same	24,750		Same
275	16,100		as	19,100		as	24,400		as
300	15,800		Silicon	18,800		Silicon	24,000		Silicon
325	15,550	Same	Killed	18,500		Killed	23,650	Same	Killed
350	15,300	as		18,250	Same		23,250	as	
375	15,000	Silicon		18,000	as		22,900	Silicon	
		Killed			Silicon			Killed	
400	14,700			17,700	Killed		22,500		
425	14,450			17,450			22,100		
450	14,150			17,200			21,750		
475	13,900			16,900			21,400		
500	13,600			16,600			21,000		
525	13,350			16,350			20,650		
550	13,100			16,100			20,250		
575	12,800			15,800			19,900		
600	12,550			15,550			19,500		
625	12,250			15,250			19,150		
650	12,000			15,000			18,750		
675	11,850		11,750	14,750			18,400		
700	11,550		11,400	14,250			17,650		
725	11,250		10,850	13,750		13,350	16,650		16,650
750	10,900		10,300	13,000		12,450	15,500		15,100
775	10,500		9,700	12,250	.....	11,450	14,000	.....	13,450
800	10,000		9,050	11,400		10,400	12,600		11,600
825	9,300		8,250	10,350		9,200	11,150		9,700
850	8,550	Same	7,300	9,250	Same	7,950	9,750	Same	8,100
875	7,800	as	6,550	8,150	as	6,750	8,350	as	6,750
900	7,000	Rimmed	5,500	7,000	Rimmed	5,500	7,000	Rimmed	5,500
925	5,850		4,350	5,850		4,350	5,850		4,350
950	4,750		3,250	4,750		3,250	4,750		3,250
975	3,600			3,600			3,600		
1,000	2,500			2,500			2,500		

*Silicon killed only.
**Not recommended for temperatures above 750°F.
[1] Silicon 0.10 to 0.25%.
[2] Silicon less than 0.10%.
[3] Not "killed" steel.
[4] See Table 27 for "S" values for oil piping outside of refinery limits.
[5] While it is possible to purchase pipe to this analysis, the silicon content shown is not in accordance with the specification listed.

Note: The above values are to be used in pipe wall thickness Formulas 9 and 10 as explained in Par. 325. In all cases, for temperatures above 650°F. if the residual silicon in the pipe material is not known to be within the limits specified hereon for "silicon killed" or "Low silicon killed" steel, the values given for "Rimmed" steel should be used.

*Senior engineer, engineering division, Detroit Edison Co., chairman of the American Standards Assn. sectional committee B31 subcommittee on plan, scope and editing of the A.S.A. Code on Pressure Piping.

†Taken from a report published in the journal, *Heating, Piping and Air Conditioning*.

ing strength of full length specimens of pipe subjected to hydrostatic bursting strength tests, was selected by the committee and reaffirmed for this edition of the code in preference to other formulas, which theoretically may be more correct.

Prior to its Sept. 30, 1941, revision, the A.S.M.E. boiler construction code differed from the power section of the code for pressure piping in that it had 2 bursting strength formulas, applicable to different size ranges, one of which differed significantly from the Barlow formula used in the piping code. In 1941, the A.S.M.E. boiler code committee revised their paragraphs dealing with computation of pipe wall thickness to agree substantially with the requirements of the piping code. This is an important step toward harmonizing the requirements of the 2 codes, parts of which cover piping in the same general classification.

A major innovation in this new edition of the piping code, also recognized now in the boiler construction code, involves introduction of the Lame' formula as an alternate method for computing pipe wall thickness, particularly where the heavier walls are involved. The new formula has been added only to the power, oil and district heating sections since the pressures involved in piping for the gas and air and refrigeration sections were not considered sufficiently high, in general, to warrant use of the more complicated formula. The following version of the Lame' formula is taken from paragraph 122 (b) of the power section:

If the nominl pipe size is 4 in. or greater, and the minimum thickness of the pipe is equal to or greater than 10% of the inside diameter, the minimum thickness may be determined from the following formula:

$$t_m = \frac{D}{2}\left[1 - \sqrt{\left(\frac{S - P}{S + P}\right)}\right] + C$$

where the symbols have the same definition as given above.

For higher pressures, the Barlow formula is overly conservative in that heavier wall thicknesses are provided than experience has shown to be necessary. The oil industry has long used a similar formula with satisfactory results in computing wall thicknesses for pressure vessels as specified in the A.P.I.-A.S.M.E. code for unfired pressure vessels.

Permits Broader Interpretation

Several notes have been added to this edition of the code which apply to the pipe wall thickness formulas, permitting a broader interpretation of the requirements. Where pipe already is on hand and available for measuring the actual thicknesses and outside diameter, it is obvious that the measured dimensions can be inserted in the formula and the corresponding working pressure computed directly for any given service temperature.

Where pipe is not yet available and has to be ordered from the mill or from jobbers' stock, the nominal wall thickness and diameter must be specified in a manner which will allow sufficient margin for underthickness and outside diameter tolerances in manufacture. Under these circumstances the pipe wall thickness formula can serve as a guide for design as noted in italics in item 3 of the third paragraph of the introduction, reading in part as follows:

The code for pressure piping represents a standard of minimum safety requirements for: (1) the selection of suitable materials and reference to standard specifications by which they may be secured; (2) the designation of proper dimensional standards for the elements comprising piping systems; (3) *the design of the component parts as well as the assembled unit* including necessary supports; (4) the erection of these systems; and (5) the test of the elements before erection and of the completed systems after erection.

Determining Thickness for Pipelines

In determining what wall thickness or outside diameter to use in designing a pipeline, it manifestly is impossible to use in the formula the *actual* measured dimensions of pipe which has not yet been made and which is subject to manufacting tolerances. Under these circumstances it is intended that the designer will compute by formula the minimum wall t_m required on inspection, using the S value of al-

Allowable Stress Values in Psi for Electric Welded Pipe within Refinery Limits[6]

(Table 23 in Sect. 3, Oil Piping Systems, of A.S.A. Code for Pressure Piping
Electric Fusion-Welded Steel[4]

A.S.T.M. A 155

Specification	Grade A Tensile Strength = 45,000 psi Yield Point = 24,000 psi		Grade B Tensile Strength — 50,000 psi Yield Point = 27,000 psi		Grade C Tensile Strength = 55,000 psi Yield Point = 27,500 psi	
Temperature Deg. F.	Silicon Killed[1,7] and Low Silicon Killed[2,7]	Rimmed[3]	Silicon Killed[1,7] and Low Silicon Killed[2,7]	Rimmed[3]	Silicon Killed[1,7] and Low Silicon Killed[2,7]	Rimmed[3]
100	13,000		14,600		14,950	
125	12,900		14,450		14,800	
150	12,750		14,300		14,700	
175	12,650		14,150		14,600	
200	12,500		14,000		14,500	
225	12,400		13,850		14,350	
250	12,250	Same	13,700	Same	14,250	Same
275	12,100	as	13,500	as	14,150	as
300	12,000	Silicon	13,400	Silicon	14,000	Silicon
325	11,850	Killed	13,200	Killed	13,900	Killed
350	11,750		13,100		13,800	
375	11,600		12,900		13,650	
400	11,450		12,750		13,550	
425	11,350		12,600		13,450	
450	11,200		12,450		13,300	
475	11,100		12,300		13,200	
500	10,950		12,150		13,100	
525	10,800		12,000		12,950	
550	10,700		11,850		12,850	
575	10,550		11,700		12,750	
600	10,400		11,550		12,650	
625	10,300		11,400		12,500	
650	10,150		11,250		12,400	
675	10,050	9,900	11,100	11,000	12,150	
700	9,850	9,600	10,800	11,650	11,700	11,700
725	9,650	9,250	10,450	10,100	11,250	11,000
750	9,400	8,750	10,100	9,600	10,700	10,350

[1] Silicon 0.10 to 0.25%.
[2] Silicon below 0.10%.
[3] Not "killed steel".
[4] In all cases for temperatures above 650°F., if the residual silicon in the pipe material is not known to be within the limits specified herein for "silicon killed" or "low silicon killed" steel, the values given for "rimmed" steel shall be used.
Note: The above values are to be used in pipe wall thickness Formulas 9 and 10 as explained in Par. 325 for determining minimum allowable pipe wall thickness.
[5] For electric resistance-welded pipe for applications where the temperature is below 650°F., and where pipe furnished under this classification is subjected to supplemental tests and/or heat treatments as agreed to by the supplier and the purchaser, and whereby such supplemental tests and/or heat treatments demonstrate the strength characteristics of the weld to be equal to the minimum tensile strength specified for the pipe, the "S" values equal to the corresponding seamless grades may be used.
[6] See Table 27 for "S" values for oil piping outside of refinery limits.
[7] While it is possible to purchase pipe to this analysis, the silicon content shown is not in accordance with the specification listed.

Allowable Stress Values in Psi for Electric Welded Pipe within Refinery Limits[6]

(Table 23, in Sect. 3, Oil Piping Systems, in A.S.A. Code Pressure Piping

Electric Resistance-Welded Steel[4,5]
A.P.I. 5L

Specification	Grade A Tensile Strength = 48,000 psi Yield Point = 30,000 psi		Grade B Tensile Strength = 60,000 psi Yield Point = 35,000 psi		Grade C Tensile Strength = 75,000 psi Yield Point = 45,000 psi	
Temperature Deg. F.	Silicon Killed[1,7] and Low Silicon Killed[2,7]	Rimmed[3]	Silicon Killed[1,7] and Low Silicon Killed[2,7]	Rimmed[3]	Silicon Killed[1,7] and Low Silicon Killed[2,7]	Rimmed[3]
100	15,300		17,850		23000	
125	15,050		17,600		22650	
150	14,850		17,400		22300	
175	14,600		17,150		22,000	
200	14,400		16,900		21,700	
225	14,150		16,700		21,350	
250	13,900	Same	16,450	Same	21,050	Same
275	13,700	as	16,200	as	20,700	as
300	13,450	Silicon	16,000	Silicon	20,400	Silicon
325	13,200	Killed	15,750	Killed	20,050	Killed
350	13,000		15,500		19,750	
375	12,750		15,300		19,400	
400	12,500		15,050		19,100	
425	12,300		14,800		18,800	
450	12,050		14,600		18,450	
475	11,800		14,350		18,150	
500	11,600		14,100		17,850	
525	11,350		13,900		17,500	
550	11,100		13,650		17,150	
575	10,900		13,450		16,850	
600	10,650		13,200		16,550	
625	10,400		13,000		16,200	
650	10,200		12,750		15,900	
675	10,100	10,000	12,500		15,650	
700	9,800	9,650	12,100	12,100	15,000	15,000
725	9,550	9,200	11,700	11,350	14,150	14,000
750	9,250	8,750	11,050	10,600	13,200	12,850

Same footnotes apply as for above Table 23 on A.S.T.M. A 155 grade.

Allowable Stress Values in Psi for Electric Welded Pipe within Refinery Limits[6]

(Table 23 in Sect. 3, Oil Piping Systems, of A.S.A. Code for Pressure Piping)

Electric Fusion-Welded Steel[4]
A.P.I. 5L

Specification Temperature Deg. F.	Grade A Tensile Strength = 48,000 psi Yield Point = 30,000 psi		Grade B Tensile Strength = 60,000 psi Yield Point = 35,000 psi		Grade C Tensile Strength = 75,000 psi Yield Point = 45,000 psi	
	Silicon Killed[1,7] and Low Silicon Killed[2,7]	Rimmed[3]	Silicon Killed[1,7] and Low Silicon Killed[2,7]	Rimmed[3]	Silicon Killed[1,7] and Low Silicon Killed[2,7]	Rimmed[3]
100	14,400		16,800		21,600	
125	14,200		16,600		21,300	
150	14,000		16,400		21,000	
175	13,750		16,150		20,700	
200	13,550		15,950		20,400	
225	13,300		15,700		20,100	Same as Silicon Killed
250	13,100	Same as Silicon Killed	15,500	Same as Silicon Killed	19,800	
275	12,900		15,300		19,500	
300	12,650		15,050		19,200	
325	12,450		14,850		18,900	
350	12,200		14,600		18,600	
375	12,000		14,400		18,300	
400	11,800		14,200		18,000	
425	11,550		14,000		17,700	
450	11,350		13,750		17,400	
475	11,100		13,500		17,100	
500	10,900		13,300		16,800	
525	10,700		13,100		16,500	
550	10,500		12,850		16,200	
575	10,250		12,650		15,900	
600	10,000		12,400		15,600	
625	9,800		12,200		15,300	
650	9,600		12,000		15,000	
675	9,500	9,400	11,800		14,700	
700	9,250	9,100	11,400	11,400	14,100	14,100
725	9,000	8,700	11,000	10,700	13,300	13,200
750	8,700	8,250	10,400	9,950	12,400	12,100

Same footnotes apply as for above Table 23 on A.S.T.M. A 155 grade.

Allowable Stress Values in Psi for Lap, Butt and Forge Welded Steel Pipe within Refinery Limits[4]

(Table 24, Sect. 3, Oil Piping Systems, of A.S.A. Code for Pressure Piping)

Specification	Lap-Welded Steel A.S.T.M. A 53 A.S.T.M. A 106 A.P.I. 5L Tensile Strength = 45,000 psi Yield Point = 25,000 psi		Butt-Welded Steel A.S.T.M. A 53 A.P.I. 5L Tensile Strength = 50,000 psi Yield Point = 30,000 psi		Forge-welded Steel A.S.T.M. A 136 Grade A Tensile Strength = 45,000 psi Yield Point = 24,000 psi		Grade B Tensile Strength = 50,000 psi Yield Point = 27,000 psi	
Temperature Deg. F.	Silicon Killed[1,5] and Low Silicon Killed[2,5]	Rimmed[3]	Silicon Killed[1,5] and Low Silicon Killed[2,5]	Rimmed[3]	Silicon Killed[1,5] and Low Silicon Killed[2,5]	Rimmed[3]	Silicon Killed[1,5] and Low Silicon Killed[2,5]	Rimmed[3]
100	11,250		10,800		11,500		12,950	
125	11,100		10,650		11,400		12,800	
150	11,000		10,500		11,250		12,700	
175	10,850		10,350		11,150		12,650	
200	10,750		10,200		11,050		12,400	
225	10,600		10,050		10,900		12,300	
250	10,500		9,900		10,800		12,150	
275	10,350		9,750		10,700		12,000	
300	10,250	Same as Silicon Killed	9,600	Same as Silicon Killed	10,600	Same as Silicon Killed	11,900	Same as Silicon Killed
325	10,100		9,450		10,450		11,750	
350	10,000		9,300		10,350		11,600	
375	9,850		9,150		10,250		11,450	
400	9,700		9,000		10,150		11,350	
425	9,600		8,850		10,000		11,200	
450	9,450		8,700		9,900		11,050	
475	9,350		8,550		9,800		10,900	
500	9,200		8,400		9,650		10,800	
525	9,100		8,250		9,550		10,650	
550	8,950		8,100		9,450		10,550	
575	8,800		7,950		9,350		10,400	
600	8,700		7,800		9,200		10,250	
625	8,550		7,650		9,100		10,150	
650	8,450		7,500		9,000		10,000	
675	8,350	8,250	7,400	7,350	8,900	8,800	9,850	9,800
700	8,200	8,000	7,200	7,100	8,750	8,500	9,600	9,500
725	8,050	8,050	6,950	6,750	8,550	8,200	9,300	9,000
750	7,850	7,300	6,700	6,400	8,350	7,800	8,950	8,500

[1] Silicon 0.10 to 0.25%.

[2] Silicon below 0.10%.

[3] Not "killed steel".

[4] See Table 27 for "S" values for oil piping outside of refinery limits.

[5] While it is possible to purchase pipe to this analysis, the silicon content shown is not in accordance with the specification listed.

The above values are to be used in pipe wall thickness Formulas 9 and 10 as explained in Par. 325 for determining the minimum allowable pipe wall thickness.

In all cases, for temperatures above 650°F., if the residual silicon in the pipe material is not known to be within the limit specified herein for "silicon killed" or "low silicon killed" steel, the values given above for "rimmed" steel shall be used.

lowable stress for the material which corresponds to the expected service conditions. Then, in order to arrive at a *nominal* thickness to specify in ordering pipe, it is necessary to add the manufacturing tolerance to the computed minimum wall thickness so that, if the pipe comes out on the light side in rolling, the wall still will be heavy enough to satisfy the minimum requirements.

Rather than specify special thicknesses in ordering pipe, which practice would be justified only on extremely large orders, it is customary to select a nominal thickness from some pipe schedule, such as A.S.A. B36.10, so as to order the standard thickness next heavier than the minimum theoretically required. Variations in wall thickness permissible within the manufacturing tolerance for commercial pipe are illustrated in Fig. 1.

To provide for those cases where actual measurements of wall thickness and outside diameter can be made on pipe already rolled, a new note has been added to the paragraph on pipe wall thickness as follows:

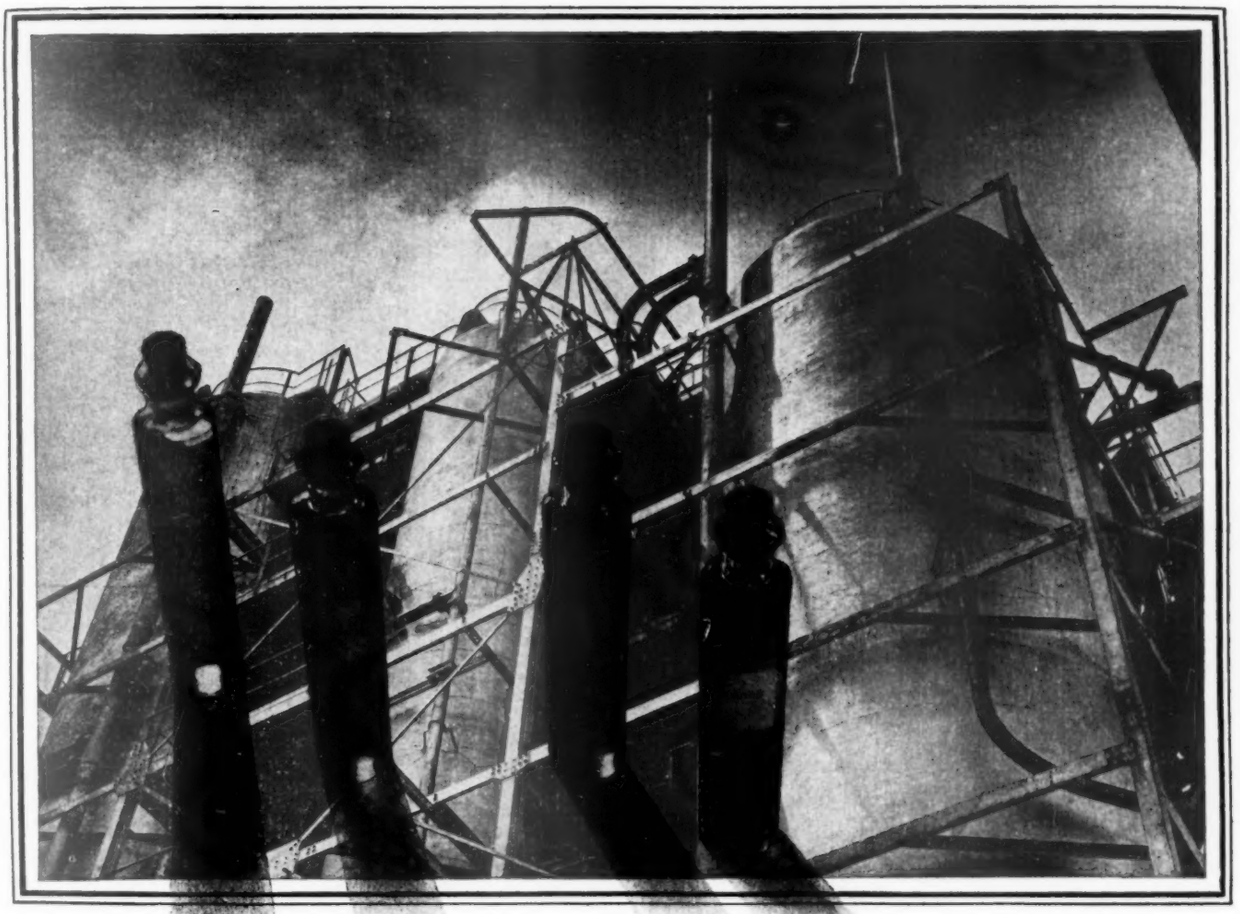
> For design, the outside diameter of pipe as given in tables of standards and specifications shall be used in obtaining the value of t_m. Where available from pipe on hand or in stock, the actual measured outside diameter and actual measured minimum wall thickness may be used to calculate the maximum internal service pressure.

Another new footnote for the same paragraph has been added to permit further latitude in computing the pressure for which a given length of pipe may be used. This is as follows:

> When computing the allowable pressure for a pipe of a definite minimum wall thickness, the value obtained by this formula may be rounded out to the next higher unit of 10.

Non-Ferrous Pipe and Tubing — Another feature of the pipe wall thickness formula which has occasioned considerable discussion since the first edition of the code involves the factor C for non-ferrous pipe and tubing. In the 1935 edition, plain end non-ferrous pipe or tubing for 1 in. size and smaller was assigned a C factor of 0.05 in., whereas for sizes larger than 1 in., the factor was 0.065. This must be added to the minimum thickness computed by the Barlow or Lame' formulas.

It was pointed out that the wall thicknesses so obtained were inconsistent with general usage of copper pipe or tubing. Where the latter is used on account of its greater flexibility, the increased thicknesses required by the code formula resulted in copper pipe too rigid for the service intended. Further, the code had always permitted seamless copper water tube in accordance with A.S.T.M. specification B88. The tables of thickness in that specification, which represent satisfactory commercial practice, were entirely inconsistent with the values of wall thickness computed with code formulas, using the allowances specified. In many cases, the corrosion allowance was equal to or greater than the corresponding commercial wall



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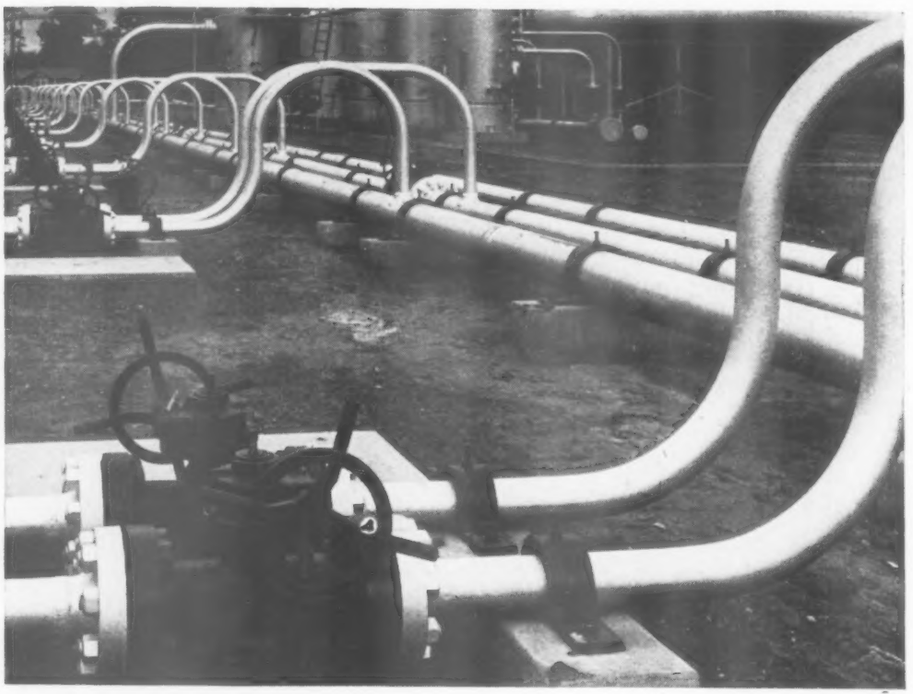
thickness, from which it might be concluded that the commercial tubing was unsuitable for service at any pressure.

Submitted for Ruling

The matter was submitted for consideration of the sectional committee, which ruled that for non-ferrous pipe and tubing conveying the fluids permitted under the several code sections, corrosion in the majority of cases was a negligible factor. In the case of plain end non-ferrous pipe and tubing, therefore, a C factor of zero is assigned. To provide adequate mechanical strength, particularly in the smaller sizes, minimum wall thicknesses were specified, which vary between the individual sections in accordance with what is considered safe practice for the fluids conveyed. Also, the following sentence is included:

Additional wall thickness shall be provided as required to care for corrosion, erosion, or mechanical strength.

These requirements correspond to those for non-ferrous pipe and tubing given in the A.S.M.E. boiler construction code, which have been found through long usage to be entirely satisfactory.



Piping installation in recycling plant in Webster Parish, La.

Allowable Stress Values for Wrought Iron Pipe, Seamless Brass and Copper Pipe and Seamless Copper Tubing and Cast Iron Pipe, within Refinery Limits

(Table 25, Sect. 3, Oil Piping Systems, of A.S.A. Code for Pressure Piping)

Specification Temperature Deg. F.	Wrought Iron A.P.I. 5L Lap Welded Tensile Strength = 42,000 psi Yield Point = 24,000 psi	Butt Welded Tensile Strength = 42,000 psi Yield Point = 24,000 psi
100	10,800	7,200
125	10,600	7,100
150	10,400	7,000
175	10,250	6,850
200	10,050	6,750
225	9,850	6,650
250	9,700	6,550
275	9,500	6,450
300	9,300	6,350
325	9,100	6,250
350	8,950	6,150
375	8,750	6,050
400	8,550	5,950
425	8,400	5,850
450	8,200	5,750
475	8,000	5,650
500	7,850	5,550
525	7,650	5,450
550	7,500	5,300
575	7,300	5,200
600	7,100	5,100
625	6,900	5,000
650	6,750	4,900
675	6,550	4,800
700	6,350	4,700
725	6,200	4,600
750	6,000	4,500

Brass and Copper	"S" Values at 350° F. and Below
Seamless brass pipe A.S.T.M. B 43	7,000
Seamless copper pipe A.S.T.M. B 42	5,400
Seamless copper tubing A.S.T.M. B 75, B 88	5,400

Cast-Iron Pipe	"S" Values for Underground Pipe Lines, 300° F and Below[1]
When casting vertically in dry sand molds	4,000
When centrifugally or horizontally cast	6,000

Note: The above values are to be used in pipe wall thickness Formulas 9 and 10 as explained in Par. 325.

[1] See Par. 306(a).

Allowable Stress Values in Psi for Seamless Alloy Pipe within Refinery Limits[1]

(Table 26, Sect. 3, Oil Piping Systems, of A.S.A. Code for Pressure Piping)

Specification Temperature Deg. F.	A.S.T.M. A 158 Ferritic 5 Chromium Tensile Strength = 60,000 psi Yield Point = 30,000 psi	A.S.T.M. A 158 Austenitic 18-Cr-8 Ni Tensile Strength = 75,000 psi Yield Point = 30,000 psi	A.S.T.M. A 206 Carbon Molybdenum Tensile Strength = 55,000 psi Yield Point = 30,000 psi
100	18,000	18,000	18,000
125	17,900	17,850	17,800
150	17,750	17,700	17,650
175	17,650	17,600	17,500
200	17,550	17,450	17,350
225	17,400	17,300	17,200
250	17,300	17,200	17,000
275	17,200	17,050	16,850
300	17,100	16,900	16,700
325	16,950	16,800	16,500
350	16,850	16,650	16,350
375	16,700	16,500	16,200
400	16,600	16,400	16,050
425	16,500	16,200	15,900
450	16,400	16,100	15,700
475	16,300	15,950	15,550
500	16,150	15,800	15,400
525	16,000	15,700	15,200
550	15,900	15,550	15,050
575	15,800	15,400	14,900
600	15,700	15,300	14,750
625	15,600	15,150	14,600
650	15,500	15,000	14,400
675	15,350	14,900	14,250
700	15,250	14,800	14,100
725	15,150	14,700	13,950
750	15,000	14,600	13,800
775	14,900	14,450	13,600
800	14,750	14,300	13,500
825	14,600	14,150	13,300
850	14,000	14,000	13,150
875	13,400	13,800	12,800
900	12,500	13,600	12,250
925	11,200	13,300	11,250
950	10,000	12,850	10,000
975	8,750	12,300	8,150
1,000	7,300	11,600	6,250
1,025	6,000	10,650	4,500
1,050	4,800	9,300	3,000
1,075	3,700	8,400	2,100
1,100	2,750	7,500	1,500
1,125	2,200	6,600	....
1,150	1,800	5,800	....
1,175	1,400	5,100	....
1,200	1,000	4,500	....

Note: The above values are to be used in pipe wall thickness Formulas 9 and 10 as explained in Par. 325.

[1] See Table 27 for "S" values for oil piping outside refinery limits.

Allowable Stress Values in Psi for Oil Piping Systems Outside Refinery Limits

(Table 27, Sect. 3, Oil Piping Systems, of A.S.A. Code for Pressure Piping)

Material	Specification	"S" Value at 100° F., Psi
Seamless steel:		
Grade A	A.P.I. 5L	25,500
Grade B	A.P.I. 5L	29,750
Grade C	A.P.I. 5L	38,250
Grade A	A.S.T.M. A 106	25,500
Grade B	A.S.T.M. A 106	29,750
Grade A	A.S.T.M. A 53	25,500
Grade B	A.S.T.M. A 53	29,750
Electric-fusion-welded steel:		
Grade A	A.P.I. 5L	20,400
Grade B	A.P.I. 5L	23,800
Grade C	A.P.I. 5L	30,600
Electric-fusion-welded steel (high pressure—high temperature service):		
Grade A	A.S.T.M. A 155	18,350
Grade B	A.S.T.M. A 155	20,650
Grade C	A.S.T.M. A 155	21,200
Electric - resistance-welded steel:		
Grade A	A.P.I. 5L	21,700
Grade B	A.P.I. 5L	25,300
Grade C	A.P.I. 5L	32,500
Lap-welded steel	A.P.I. 5L	15,950
	A.S.T.M. A 106	15,950
	A.S.T.M. A 53	15,950
Butt-welded steel	A.P.I. 5L	15,300
	A.S.T.M. A 53	15,300
Forge-welded steel:		
Grade A	A.S.T.M. A 136	16,300
Grade B	A.S.T.M. A 136	18,350
Lap - welded wrought iron	A.P.I. 5L	15,300
Butt - welded wrought iron	A.P.I. 5L	10,200
Seamless brass pipe	A.S.T.M. B 43	10,000
Seamless copper pipe	A.S.T.M. B 42	7,500
Seamless copper tubing	A.S.T.M. B 75	7,500
	A.S.T.M. B 88	7,500

Note: The above values of "S" are to be used in the pipe wall thickness Formulas 9 and 10 as explained in Par. 325.

Note: For electric resistance-welded pipe for applications where the temperature is below 650° F., and where pipe furnished under this classification is subjected to supplemental tests and/or heat treatments as agreed to by the supplier and the purchaser, and whereby such supplemental tests and/or heat treatments demonstrate the strength characteristics of the weld to be equal to the minimum tensile strength specified for the pipe, the "S" values equal to the corresponding seamless grades may be used.

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Characteristics of Greases at Low Temperatures*

By Thomas A. Maxwell**

Lubricating greases must perform satisfactorily over a wide range of temperatures in service in airplanes of this type, the Navy's Mars, largest ship to fly, whose four 2000-h.p. motors can take her non-stop over a good section of the globe. Stood on one wing tip the other would reach the top of a 20-story building. Cubic content of her hull is equivalent to that of a 15-room house

Laboratory studies were made of the characteristics of different soap bases and different oil viscosities in greases, to establish their role in determining the behavior of greases in ball bearing service at low temperatures. Such data is recognized as of value in the manufacture of bearing greases to meet military service conditions in aircraft particularly. The apparatus is described by which the tests were made on the various types of greases.

The conclusion was that low temperature bearing torque characteristics of greases made from different metal bases and low viscosity index oils appeared to depend chiefly on the viscosity of the oil used.

THE strategic importance in military operations of an adequate supply of lubricants satisfactory under extremes of temperature and humidity has prompted close study of many phases of the problem. Good lubricating qualities, mechanical and chemical stability at high and low temperatures without oil evaporation or separation, resistance to deterioration by moisture, and minimum change of effective consistency with temperature are the chief desiderata. While generally speaking any one grease might be called upon to function under such extremes of conditions, it is a matter of utmost importance to the military, and has long been a desire of the trade, that the full range of service should be covered by a minimum number of lubricants.

One specific phase of service requiring a special lubricant has been the exposed bearing of military aircraft. These may alternately be roasted under tropical suns and chilled to perhaps —100°F. on nocturnal flights at high levels.

The study covered in this paper was undertaken as background for fabrication of lubricants suitable for such service, to establish the role of different soap bases and different oil viscosities in determining the behavior of greases in ball bearing service at low temperatures.

To evaluate the performance of the test lubricants at low temperatures, the torque test outlined in Army-Navy Specification AN-G-3 of May 30, 1942, was used. An 8-ball, 204 open bearing was packed with 5 grams of grease, closed with slip fit shields, and run in 100 turns each way. The bearing was then chilled on a straight line curve to test temperature in two hours and soaked for one hour, rotating two turns every 15 minutes. At the end of the soaking period the time necessary for a complete revolution with 2000 gm-cm applied torque was determined.

Apparatus Listed

The apparatus used, shown in Figs. 1, 2, and 3, consisted of a cold bath, a block for sup-

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**Chief chemist, International Lubricant Corp., New Orleans.

Table 1—Time in Seconds for Revolution of Test Bearing at Indicated Temperatures

Temp.	Oil Viscosity Saybolt @ 100°	Aluminum Base	Sodium Base	Lithium Base	Lead Base	Calcium Base	Barium Base
—67° F.	100	950	507	535	...	653	1950
—67° F.	57	17	17	19	16	22	55
—67° F.	40	4	...	<1	<1	...	...
—67° F.	34	<1	<1	<1	<1	<1	<1
—100° F.	57	...	600	600	Frozen	...	...
—100° F.	40	...	...	85	92	...	...
—100° F.	34	<1	<1	<1	1	...	1
—120° F.	34	3½	½	4	...	...	3½
—150° F.	34	502	182	420	...	...	1300

porting test bearings, spindles, a fan, thermocouples, and accessories for producing and measuring temperature and torque. The cold bath comprised a cylindrical one gallon silvered glass vacuum jug inside a protective wooden case. An oak block 8 ins. square and 8 ins. long was turned down along 7 ins. of its length to a cylinder which fitted loosely into the vacuum jug, that is, about 6 ins. diameter. The 8-in. square top overhanging the cylinder fitted snugly into the outer wooden case flush with its top and rested on an inside shelf so that the block was held in fixed position not touching the jug. This block was drilled for 4 vertical spindles, symmetrically placed as shown, a centrally placed fan shaft, a small inlet and outlet for refrigerant, and a tube for thermocouple leads.

Each test bearing was held in place by 3 steel pins projecting from the block. The outer race of each bearing was notched in one place sufficiently that the pressure of a pin at this point prevented rotation. These pins projected 1-in. from the block and the bearings were supported 0.5 in. from the block. The cylindrical spindles were of oak with metal caps at the cold end so threaded that the inner race of the test bearing could be held tight by a lock nut. The upper spindle guide bearing was held permanently in place by large screws and was packed with a very light grease. The top inch of the spindle was square in cross section to accommodate a 4-centimeter pulley with square hole to match. A small glass tube housed the 8 thermocouple leads, while two 0.25 in. glass tubes served as inlet and outlet for refrigerant. The small fan shaft was housed in a glass tube shrunk to bearing clearances at either end. This was powered first by motor and pulley and then more conveniently by a small air turbine. A portable potentiometer was used to measure the thermocouple voltage, with the usual ice bath cold junction.

Refrigeration

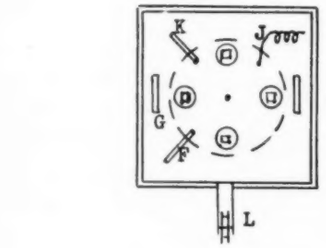
Refrigeration was achieved and controlled manually by admitting small increments of liquid nitrogen directly to the bottom of the cold bath, where it immediately boiled to a gas absorbing heat from the air which was swirled rapidly about the bearings. Since the annular spaces about the block and the spindles were sealed at the top the dead gas space was an effective insulator; the thermal leakage was small in proportion to the thermal capacity; and close control was possible, while the low heat capacity permitted close control of the rate of cooling. The temperature range was limited only by the temperature of liquid nitrogen some 320°F. below zero. For flexibility, range, and freedom from moisture condensation the unit compared most favorably with carbon dioxide cooled units.

Another piece of apparatus which proved of interest in this study was one patterned after a unit described in the British Air Ministry's Specification DTD 201, "Controls Lubricating Oil". We constructed a modified multiple bearing unit and did some preliminary work which proved interesting. We discontinued this test, however, in favor of establishing a foundation with the standard test, to which we might later correlate results of the simpler unit.

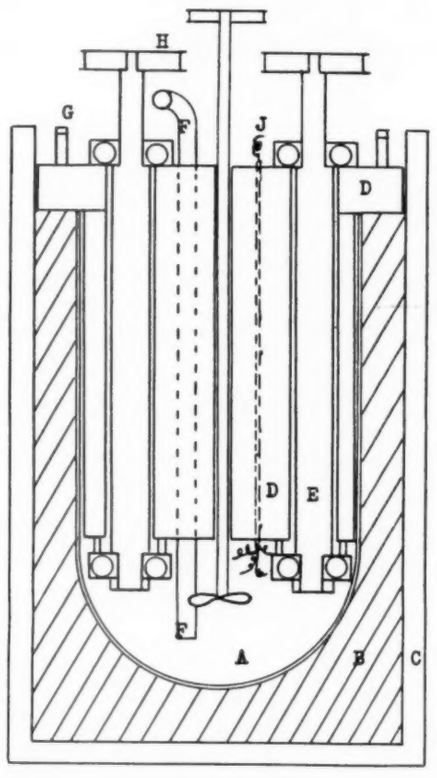
Our modification consisted of a 0.5-in. steel ball on the end of a ⅛-in. shaft, seated into a brass socket bearing. The socket was held by a rubber sleeve in the flared end of a glass condenser tube, the upper end of which was shrunk to a bearing fit about the ⅛-in. shaft. A pulley on the shaft above the tube served for applying torque and supporting the loading weights when used. We used 4 such units mounted vertically through a lid which fitted the cold bath used for the ball bearing test. For coolant we used a liquid bath of acetone chilled with dry ice.

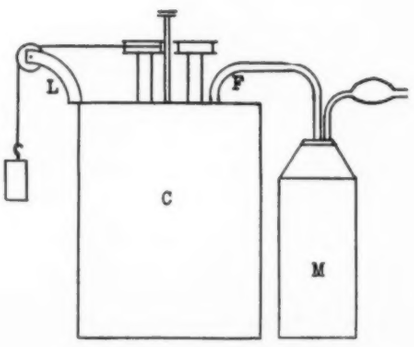
Our preliminary work indicated that the torque characteristics of greases in the range of useful consistencies were of the same order of magnitude as that of the base oil from which they were fabricated.

The lubricants tested in the ball bearing torque apparatus comprised greases of from 310



A - 1 Gallon Vacuum Jug
B - Mechanical Packing
C - Protective case 9x9x15"
D - Machined Oak Block
E - Machined Oak Spindle with threaded cap on lower end
F - Liquid Nitrogen inlet (Oversize in sketch)
G - Two handles for oak block
H - Pulley of 2 cm radius
J - Four Thermocouple leads
K - Nitrogen gas outlet
L - Ball Bearing Pulley and support
M - Liquid Nitrogen reservoir





Figs. 1, 2 and 3—Sketch of apparatus for investigation of low temperature performance of ball bearing greases

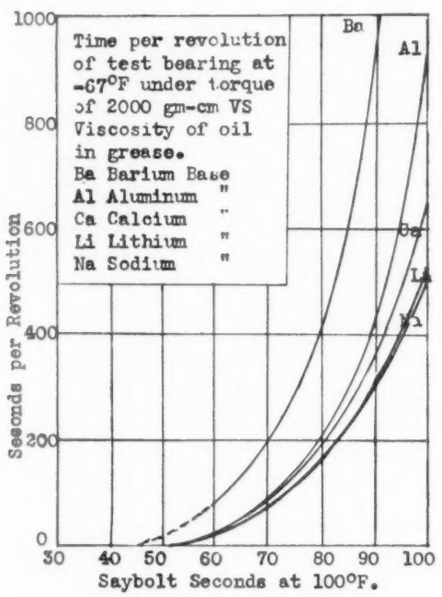


Fig. 4—Relation between time of revolution and oil viscosity for 5 greases at —67 F

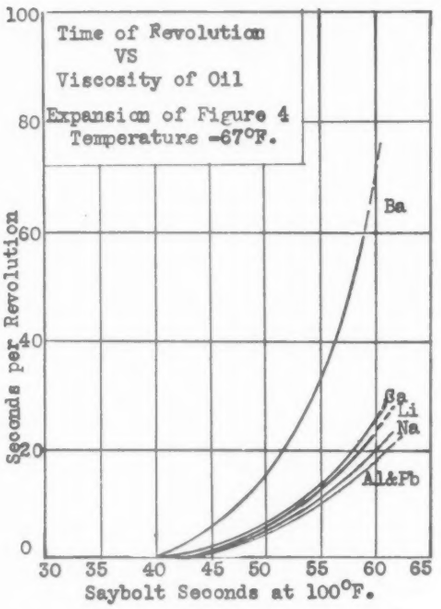


Fig. 5—Expansion of portion of the area shown in Fig. 4

to 340 A.S.T.M. worked penetration made from 6 metallic bases and 4 base oils. Test samples were prepared as nearly free as possible from fibrous or granular structure and were of anhydrous type. No mixtures were tried. The fatty material used in compounding the greases was not identical in all cases, but was varied according to the requirements of the individual metal bases.

The oil designated as 100 vis. was a conventionally refined naphthenic stock from a Louisiana crude and had a viscosity index of 25, a flash of 325°F., and a pour of —60°F. The 57-vis. oil was of similar type, lower in viscosity and flash, with a pour point of —65°F. The 40-vis. stock was a highly refined stock of 310°F. flash and —65°F. pour. The 34-vis. oil was a gas oil from a local crude.

For the purpose of this testing the volatility characteristics of such light stocks were not considered. The object was to find the range of stocks suitable from the standpoint of low temperature performance without regard to other characteristics.

In TABLE I are shown the time of revolution of test bearings at the temperatures indicated. Very high and very low values are to be taken only as indicative of the order of magnitude involved.

The relation between time of revolution and oil viscosity for the various greases at —67°F. is shown graphically in Fig. 4. Bearing in mind the inaccuracy of the test measurement for very stiff greases, the dispersion at the higher oil viscosities is not to be taken too literally. With the exception of the Barium grease the torque values are similar for the different bases to a degree within the limits of control of manufacture. Fig. 5 represents an expansion of a limited area of Fig. 4. Since a time of about 30 sec. is the maximum permissible in a satisfactory grease, the use of an oil of viscosity less than about 60 at 100°F. is indicated. For Barium greases an even lighter oil might be necessary.

Many other factors might play a part in the choice. No tests were run on high soap content greases milled down to the desired consistency, nor on fibrous greases. Preliminary tests on Sodium base greases incorporating small amounts of organic esters seemed to indicate that such products were effective for reducing torque only as they reduced the effective oil viscosity.

Fig. 6 shows the logarithm of the time of revolution plotted against the oil viscosity at 100°F. The nearly linear nature of the curve indicates some logarithmic relationship between torque and viscosity. Fig. 7 depicts the relationship between the time of revolution at —100°F. and oil viscosity at 100°F. of 3 types of grease. The relative unimportance of the metal base in determining torque characteristics is still apparent.

The 4 greases tested at —120°F. and —150°F. appear at first glance to be very different in torque characteristics; but, since they were all very satisfactory at —120°F. and there is currently little interest in greases functioning at —150°F., it may be assumed that the limiting oil viscosity for greases satisfactory at —120°F. will be somewhere in the neighborhood of 36 to 40 sec. at 100°F.

In summary it may be stated the low temperature bearing torque characteristics of greases fabricated from different metal bases and low viscosity index oils appeared to be dependent chiefly on the viscosity of the oil used. Barium greases seemed to stiffen somewhat above the average of the other greases tested.

Since the use of very light oils is dictated by low temperature requirements, part of the problem lies with the refiner to produce stocks of the best possible volatility characteristics for the grease compounder to try his art on. Much work remains to be done in determining the effect of viscosity index, of phenomenal pour points, of blending agents, and of extreme pressure and/or oiliness additives which may be added to light oils.

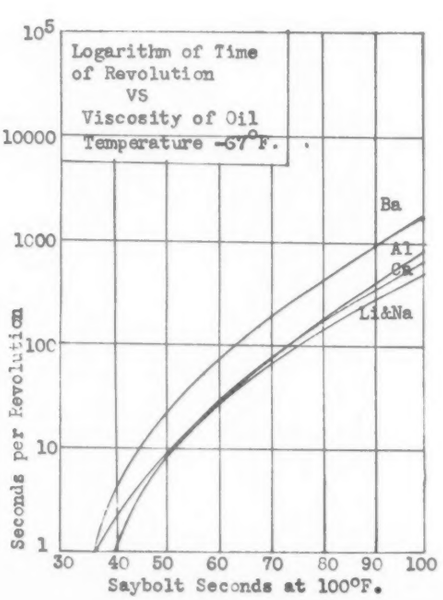


Fig. 6—Logarithm of time of revolution plotted against the oil viscosity at 100 F

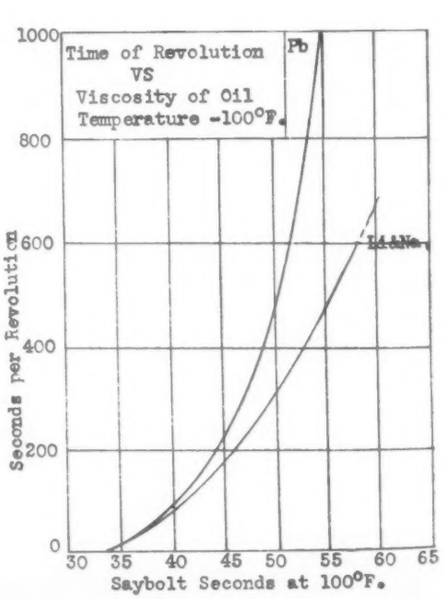


Fig. 7—Relationship between time of revolution at —100 F and oil viscosity at 100 F of 3 types of grease

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Dow Chemical Method of Manufacturing Ethylbenzene and Styrene Described

THE methods used by Dow Chemical Co. for the manufacture of ethylbenzene, and this in turn into styrene, were described by Dr. Willard Dow, president of that company, at the last meeting of the American Chemical Society and have recently been published by the society.

Styrene, in addition to being one of the components of Buna S synthetic rubber, said Dr. Dow, will find increasing use as a basic material for plastics, in that it is well adapted to certain molding procedures and is strong, tough and attractive because of crystal clarity as well as its unlimited color possibilities.

In the Dow company operations ethylene is produced by high temperature cracking of hydrocarbon fractions, including ethane, and the ethylene is reacted with benzene in the presence of aluminum chloride as a catalyst at temperatures of about 190°F. and 15 lbs. gage pressure, to form ethylbenzene. The ethylbenzene vapors, mixed with highly superheated steam, are dehydrogenated into styrene.

Technologists with the oil companies, in the early stages of the program to recover materials for synthetic rubber from existing refinery equipment, developed 2 other methods to produce ethylbenzene for styrene.

In one, announced by Atlantic Refining Co., ethylbenzene was manufactured by catalytic alkylation of ethyl alcohol and benzene using a solid phosphoric acid type catalyst, operating at around 600°F. temperature and 250 p.s.i. These conditions made possible the use of low temperature furnaces with carbon steel tubes and catalyst chambers of ordinary sheet steel. The same process using the same catalyst could be adapted charging ethylene in place of ethyl alcohol where the former was available in substantially pure state.

Another method was also proposed for the synthesis of ethylbenzene from benzene and ethylene where they were charged continuously into catalytic converters of the Houdry type at approximately 900°F. and 50 lbs. pressure. A different type of catalyst, but one commercially available in quantities, was used.

In place of cracking, the early method of manufacture of styrene by the Dow Chemical Co., said Dr. Dow, consisted in forming ethylbenzene from benzene and ethyl chloride. The ethylbenzene was then chlorinated to yield a mixture of alpha and beta chloroethylbenzene. The beta compound was separated and hydrolized to give beta phenylethyl alcohol, which was then dehydrated with an alkali to yield a relatively pure styrene. Present commercial methods were described as follows by Dr. Dow:

Present Commercial Method

By DR. WILLARD DOW,
President of Dow Chemical Co.

The story of the development of our present commercial method for the manufacture of styrene begins in 1933. For some time prior to that year, considerable research on the cracking of hydrocarbons to yield unsaturates such as ethylene had been in progress in our laboratories. At least 3 methods had been worked out. A group of research workers, not associated with the cracking problem, had been in a position to observe most of this work. Some of these men were experienced organic chemists, and the thought of large quantities of relatively inexpensive ethylene stimulated their imagination.

In their background of experience they had accumulated a store of knowledge on the Friedel-Crafts reaction, and they could see the possibility of cheep ethylbenzene. Before their eyes were satisfactory crackings processes and the possibility of dehydrogenating ethylbenzene to styrene seemed to merit investigation. The problem was fully recognized and the solution appeared to be reasonably simple. It was not! Even when guided by such knowledge as could be gained from the literature, added to the technical "know how" of the investigators, it required over 3 years and the efforts of a large group of chemists and engineers to work out the process to the point where a satisfactory product was obtained.

The ethylbenzene reaction did not require too much time and effort, and the basic work on producing this intermediate material was completed in 2 or 3 months. A great deal of subsequent research was necessary to perfect the process and make it commercially useful. Various cracking procedures were tried, and then concentrated effort was put upon the process, involving mixing the preheated vapors of ethylbenzene with highly superheated steam. It was found that high yields could be obtained by this procedure without producing free carbon or tar in the condensed reaction product.

The next step was the separation of the styrene from other products of pyrolysis. This purification was a tedious problem, and in many instances we thought it was solved only to discover that the polymer formed from monomer we thought pure would still blush and craze. In one instance it was reported the problem was licked. Some days later this proved to be the story: Five gallons of the best monomer were taken to an excellent still, and an attempt made to clean up the product once and for all. The run was made under ideal conditions and the product was analyzed at short intervals by the bromide-bromate titration method for unsaturates. When the analysis showed a purity of 99.9+ per cent, this fact was reported. No immediate report was made that the purity ultimately went to 104 per cent. That is how the presence, theretofore undetected, of phenylacetylene was recognized. Monomer purity is the most important single thing to be considered in the preparation of styrene polymers and copolymers, particularly as to the styrene-butadiene copolymer.

The incident of finding a monomer still column suddenly full of solid polystyrene was a real headache, until it was discovered that sulfur would prevent this. If you want to spend money like the proverbial sailor, as well as gain a respect for the sheer cussedness of styrene, try the problem of continuous polymerization of the monomer.

On hot working the polymer in molding and compounding operations, we sometimes get molecular degradation with a consequent viscosity decrease and loss of strength and toughness. Also, we occasionally have the problem of discoloration on drying the polymer to remove the last traces of monomeric styrene. Investigation of this problem revealed that certain hydrocarbon-substituted catechols prevent such discoloration and degradation, and permit reproducibility of properties in polymers. As a safety measure, therefore, we have found it advisable to incorporate *tert*-butylcatechol in the order of 1 part in 20,000 parts of monomeric styrene as a stabilizer.

It was necessary early in the development to determine the probable toxicity of the monomer. We find that monomeric styrene may be handled with the same precautions now observed in the building of common aromatic hydrocarbon solvents. It is worth noting that the extreme eye and nose irritation produced in man at a concentration of 1300 parts per million affords a definite safeguard against voluntary exposure to acutely hazardous concentrations of monomeric styrene vapor. Concentrations up to 400 p. p. m. do not produce appreciable eye and nose irritations in man and appear to present no serious industrial hazard; therefore this figure is suggested tentatively as the permissible limit for repeated exposures.

It is interesting to make a brief comparison of the Dow method with some of the other processes considered for the production of ethylbenzene to be used in making styrene. One proposed process utilizes benzene and 95% alcohol as starting materials. These are reacted in the presence of a solid catalyst containing phosphoric acid at temperatures around 600°F. and pressures of the order of 250 p.s.i. Another process advanced is similar, except that ethylene is substituted for alcohol.

In both of these processes benzene and ethylene must be recycled several times, and the yield of ethylbenzene is claimed to be about 200 pounds per pound of catalyst. Both processes require nitration-grade sulfur-free benzene, which has a 1°F. boiling range. In contrast to such processes, the one which we have developed will actually use ethylene in admixture with other hydrocarbons in concentrations as low as 38 per cent ethylene, provided the gas is nearly propylene-free. Of course a more concentrated ethylene is desirable if it can be economically obtained. The operating temperature of our process is only about 190°F., and the pressure is relatively low, 15 pounds gage. Aluminum chloride is used as a catalyst, and 75-100 pounds of ethylbenzene can be obtained per pound of catalyst with a nitration grade of benzene. Scrap aluminum can be used in preparing a satisfactory catalyst as well as

cheap bauxite. Our process can use a less pure benzene with a boiling range of 2°F., with no substantial adverse effect on the quantity of ethylbenzene obtained per pound of catalyst.

The presence of sulfur in the benzene is not objectionable in our process, inasmuch as the aluminum chloride catalyst used promotes the formation of hydrogen sulfide gas which is vented from the system. Small amounts of unsaturates can also be tolerated in the benzene. The yield of ethylbenzene which can be obtained by operating according to our continuous procedure is nearly theoretical. No ethylene is recycled in the Dow process. A particular advantage arises out of the substantial dealkylation of any polyethylbenzenes formed simultaneously with monoethylbenzene. Procedures have been satisfactorily worked out on a pilot plant scale for recovering as high as 80% of the spent aluminum chloride catalyst and are now being extended to commercial plant operation.

Although over 95% of our present production of polystyrene is going directly into war uses on priority ratings of A-1-I or higher, styrene is distinctly not a "war baby". It will continue to find use as a basic material in elastomers. We visualize the refinement of the material and its expanding use as a moldable thermoplastic. It is peculiarly adapted to fabrication by the procedure known as injection molding. It is strong, tough, and exceedingly attractive because of its crystal clarity as well as its unlimited color possibilities. We look forward confidently to the future of styrene in the radical improvements in consumers' goods which will occur upon the cessation of hostilities.

Handbook on Oil Burners Revised, New Data Added

"An Oil Burner Handbook", by L. J. Whelan, has been revised since the 1940 edition and a new section added covering industrial oil burners. The text, written in layman's language, is in 3 parts: domestic oil burners, industrial burners and care of the oil-burner. Under the first part is included fuel for domestic burners, storage tanks, installation of burners, controls, electrical connections, servicing of burners, definitions of terms used and regulations pertaining to burners and oils in New York City. The second part covers industrial fuel oils and burners and their installation. The third part deals with how to start the burner, its regular care and other problems. Scattered through the text are descriptive charts and tables of information. At the end of each chapter are questions to check the reader's assimilation of the important points covered.

The author is head of the Oil Burner Department of New York Technical Institute and has had active work in the field as well as his experience in instructing classes on this subject. The second edition of the handbook, pocketsize, of 245 pages, sells through the Book Department, National Petroleum News, Cleveland, for $2.50 postpaid within the U. S.

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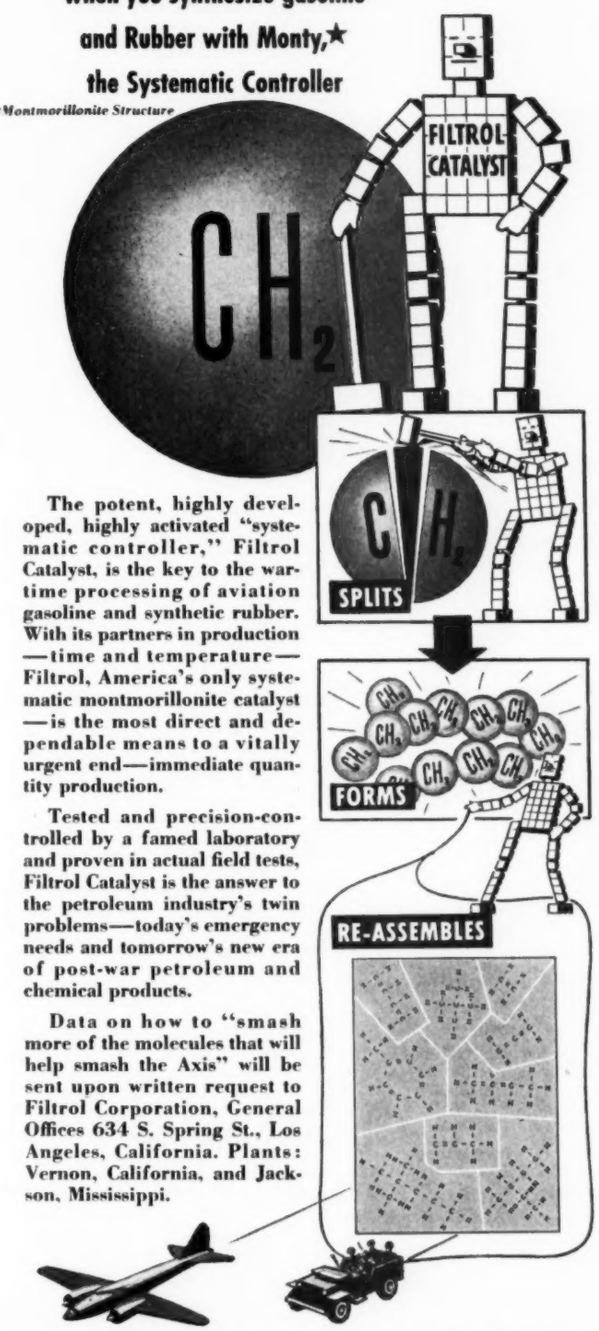

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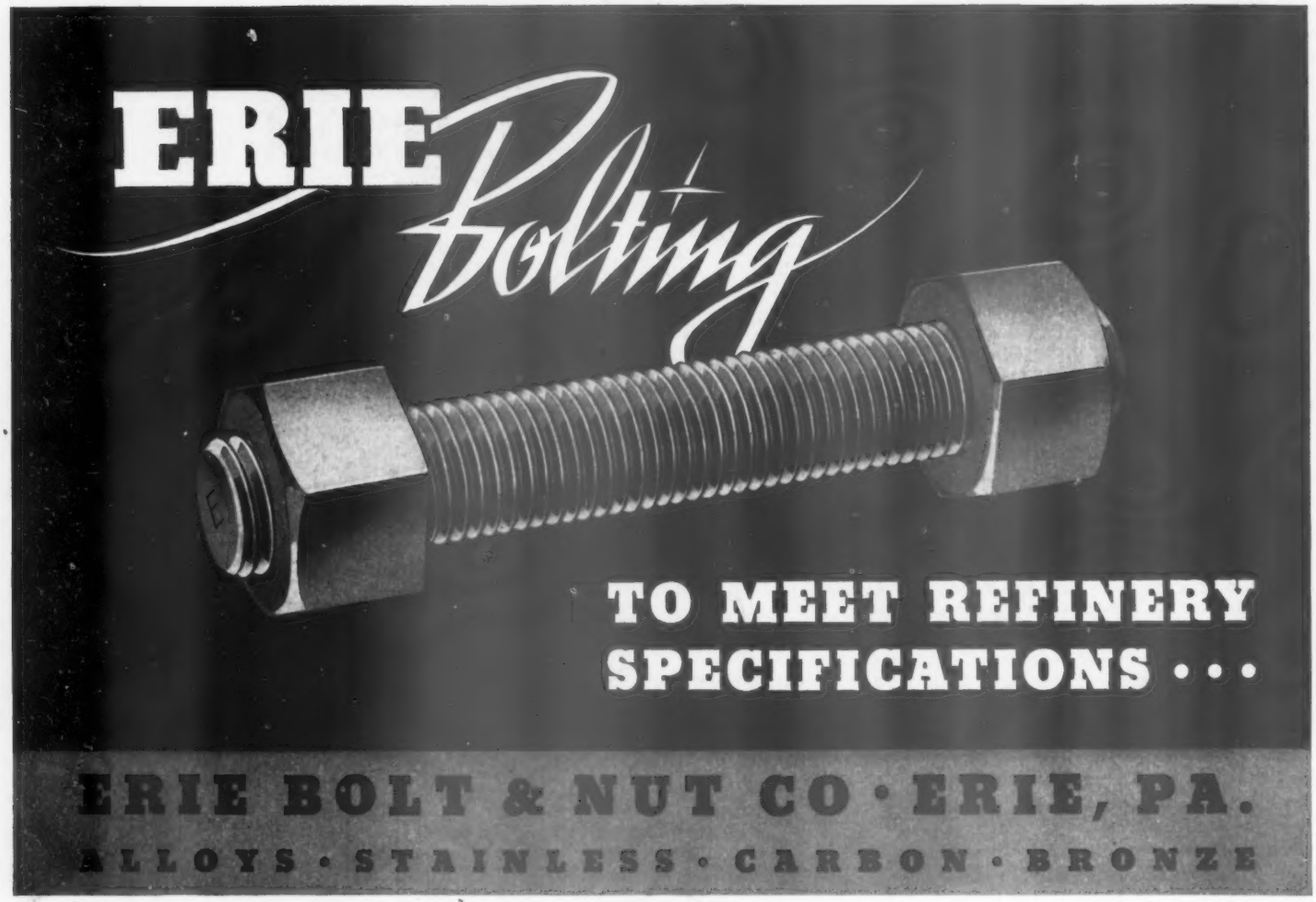

Contents

TECHNICAL SECTION—Jan. 6, 1943

War Program is Stimulating the Development of Means for More Selective Processing of Hydrocarbons, by Per K. Frolich ..... R- 3

Women Take Over Men's Plant Jobs in Wartime Emergency ..... R- 4

Maximum Yields of Liquefied Petroleum Gases Sought by Wartime Gasoline Plants R- 7

Corrosion Control in Refinery Pressure Vessels by Arc Welded Stainless Steel Linings R-10

Chemical Utilization of Natural Gas and Natural Gasoline Hydrocarbons by Oxidation R-15

100,000-Barrel Concrete Tanks for Fuel Oil Built by "Prestressing" the Reinforcing Rods R-20

Synthetic Rubbers—Article II in Series, ABC of Chemical Derivatives from Petroleum, by R. L. Wakeman and B. H. Weil R-23

New Books Reviewed R-31

Standard Refinery Piping Practice is Prescribed in New Code R-32

Application of New Piping Requirements in Refineries and Natural Gasoline Plants R-34

New Method for Computing Pipe Wall Thickness Provided in Revised Code R-36

Characteristics of Greases at Low Temperatures, by Thomas A. Maxwell R-42

Dow Chemical Method of Manufacturing Ethylbenzene and Styrene Described R-46

NOTE—The decimal numbers which appear in the margin opposite the headings of articles throughout the Technical Section are for the benefit of readers who use the Uren Decimal Index System in filing and indexing articles.

INDEX TO ADVERTISERS

Technical Section

This index is published as a convenience to the reader. Every care is taken to make it accurate, but National Petroleum News assumes no responsibility for errors or omissions

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Filtrol Corp. R-47

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Petroleum Rectifying Co. of Calif. .. R-33
Phillips Petroleum Co. .....

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Taylor Instrument Companies .....

Universal Oil Products R-21